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IL-3020-D1180

APPENDIX C

HEALTH AND SAFETY PLAN,
DEAD CREEK PROJECT

February 1986

Prepared for:
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

ecology and environment, inc.

HAZARDOUS AND TOXIC MATERIALS TEAM
SITE SAFETY PLAN

A. GENERAL INFORMATION

SITE: Dead Creek Project Job No.: IL-3020
LOCATION: Sauget and Cahokia, Illinois
PLAN PREPARED BY: Dan Sewall DATE: 2/6/86
APPROVED BY: (Initial Review of Draft) DATE: 2/7/86
OBJECTIVE(S): Monitoring Well Installation, Surface and Subsurface Soil Sampling,
Surface and Groundwater Sampling, Soil-Gas Survey.
PROPOSED DATE OF INVESTIGATION: March - May 1986:
BACKGROUND REVIEW: Complete: Preliminary: X
DOCUMENTATION/SUMMARY: Overall Hazard: Serious: X Moderate:
Low: Unknown:

B. SITE/WASTE CHARACTERISTICS

WASTE TYPE(S): Liquid X Solid X Sludge X Gas
Corrosive X Ignitable X Radioactive Volatile X
Toxic X Reactive X Unknown X Other (Name) teratogenic; carcinogenic,
mutagenic

FACILITY DESCRIPTION: The study area consists of 18 sites (370 acres) including: manu-
facturing facilities, inactive landfills, surface impoundments, and Dead Creek.

Principal Disposal Method (type and location): Landfill (area filling), waste piles,
surface impoundments, open dumping.

Unusual Features (dike integrity, power lines, terrain, etc.): Power lines traverse
the entire area west of Rte 50. A flood control levee is located immediately east of
Site Q - see map.

Status: (active, inactive, unknown) Inactive, other than manufacturing facilities.

History: (injuries; complaints; previous agency action): Illinois EPA has received
several complaints dating back to the early 1970's concerning dumping in Dead Creek. A
fence was constructed around the creek and Site M from Judith Ln. to Queenv Ave. as a
result of a preliminary study done by IEPA in this area. The Illinois Pollution Con-
trol Board and the Attorney General's Office have been involved in actions concerning
Sites Q and R.

C. HAZARD EVALUATION
(Use Supplemental Sheets if Necessary)

Summary (attach copy of available chemical information from Saxs, Merck Index, Chmtads, etc.): The following is a brief list of contaminants found at various sites in the study area during past agency and contractor investigations. This list is by no means a complete compilation of all contaminants found or suspected, and is provided simply as an indication of the types of contaminants which may be encountered during field activities.

2,3,7,8-TCDD (Dioxin)

PCB's (Not specified)

o-Dichlorobenzene

Dichlorophenol

Lead

Cadmium

Arsenic

Chlorotoluene

Phosphorus (not specified)

Pentachlorophenol

Vinyl chloride

Phosgene

Mercury

See attached hazard evaluation sheets for specific information.

D. SITE SAFETY WORK PLAN

PERIMETER ESTABLISHMENT: Map/Sketch Attached? Yes Site Secured? A

Perimeter Identified? Yes Zone(s) of Contamination Identified? B

A. Secured sites include: Dead Creek (Queeny to Judith); Sites I, M, N, R.

B. Zones preliminarily identified - investigation incomplete. Assume entire area to be contaminated.

PERSONAL PROTECTION:

Level of Protection: A B X C X D X

Modifications: MINIMUM protective clothing will include: neoprene boots (steel toe and shank), hooded Tyvek or Saranac coveralls, neoprene gloves, disposable latex booties, disposable latex gloves, hard hats. See attachment for task-specific levels of protection.

Surveillance Equipment and Materials: All field activities will include monitoring with an Hnu (10.2 lamp) or OVA, rad-mini, and cyanide meter or monitox, and an explosi-meter/O₂ meter, GCA/MDA real time particulate meter.

PERSONAL PROTECTION (Cont.):

Action Levels:

OVA/Hnu - 0 ppm above background - Level D

1 - 5 ppm above background - Level C

6 - 500 ppm above background - Level B - Contact Regional Safety Coordinator (RSC) prior to upgrade.

>501 ppm above background - Level A

O₂ Meter - <19.5% - Level B

>25% - Leave area, contact RSC.

Explosimeter - <20% LEL - Continue operation.

20-50% LEL - Identify source, initiate vapor suppressional measures

>50% LEL - Leave area

Particulate Monitor - >2 mg/m³ - Initiate dust suppression measures

Monitox CN Monitor - >5 mg/m³ - Level A

Rad-mini - Any readings - depart site and contact RSC.

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SPECIAL SITE CONSIDERATIONS: See attachment.

DECONTAMINATION PROCEDURES:

Personal: Disposable protective clothing will be bagged, labeled, and drummed.
Boot and glove wash with TSP and water. Formal hot line set up necessary.

Equipment: TSP & water wash with rinse as necessary. Sampling equipment: TSP-water
wash followed by solvent rinse (acetone-hexane-acetone) DI water rinse. All drilling
equipment (augers, split spoons...) to be steam-cleaned.

INVESTIGATION - DERIVED MATERIAL DISPOSAL: (Note - If material is proposed to be left on
site, written authorization is to be received by the Project Team Leader prior to the
initiation of on site activities): Drill cuttings, purge water will be containerized and
moved inside Dead Creek fence. Other disposables will be bagged, labeled, and container-
ized prior to moving inside Dead Creek fence.

SITE ENTRY PROCEDURES: Decontamination station will be determined each day based on
weather conditions. Entry procedures will include ambient air monitoring with surveil-
lance equipment.

<u>Team Member</u>	<u>Responsibility</u>
<u>Mike McCarrin</u>	<u>Team Leader</u>
<u>Dan Sewall</u>	<u>Safety Officer</u>
<u>*</u>	<u>TBA</u>
<u>*</u>	<u>TBA</u>
<u>Drillers/subcontractor personnel</u>	

*Additional members to be determined. Project log book will include team members and
dates present for all field activities. All subcontractor personnel are to provide SSC
with written certification of medical approval, training status, and ability to wear
specified respiratory equipment.

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SPECIAL SITE CONSIDERATIONS

All drilling locations will be cleared using a magnetometer prior to initiating drilling. Local utilities will be contacted to define subsurface transmission lines. Maneuverability is limited in Dead Creek area north of Judith Lane. Care should be taken to minimize stressful conditions resulting from extreme temperatures. Heat stress symptoms will be monitored and recorded in the SSC's log book. Work will be conducted during daylight hours only. Air compressor to be located upwind of site at all times during filling operations. Air quality for hydrocarbons, CO, moisture to be checked prior to use.

E. EMERGENCY INFORMATION

(Use Supplemental Sheets if Necessary)

EMERGENCY PRECAUTIONS

Acute Exposure Symptoms

Chlorotoluene: Severe irritation of skin
and respiratory system

Pentachlorophenol: Dust and vapors
irritate skin and mucous membranes -
severe coughing and sneezing

PCB's: Rash and acne from dermal contact

2,3,7,8-TCDD: Acne, skin and eye irrita-
tion, respiratory distress

First Aid

Wash irritated areas with water; get
medical aid

Ingestion: Immediately induce vomiting

Dermal: Wash affected areas with soap
and water

Ingestion: Provide water, induce vomiting

Dermal: Soap and water wash

*See attached hazard evaluation sheets for additional information.

LOCAL RESOURCES

(Name, Address and Phone Number)

LOCAL AREA CODE: 618

Ambulance 332-6600 Sauget Fire Dept.

Hospital Emergency Room 874-7076 Christian Welfare Hospital

Poison Control Center 1-800-252-2022 St. John's Hospital - Springfield

Police (incl. Local, County Sheriff, State) 332-6500 (Sauget), 1-277-3500 (County),
345-1212 (State)

Fire Department 332-6600

Airport 337-6060 Bi-State Parks Airport, Cahokia

Explosives Unit 345-1212 - State Police

Agency Contact (EPA, State, Local, USCG, etc.) 217/782-6760 - Jeff Larsen - IEPA

Local Laboratory 235-1780 - St. Clair Medical Laboratory

Federal Express 314/367-8278; 6181 Aviation Dr., St. Louis Airport

Client Contact Jeff Larsen, IEPA - Springfield 217/782-6760

SITE RESOURCES

Water Supply 5 gallon collapsible containers will be used.

Telephone Falling Springs Rd. and Queeny Ave.; Rte. 3 and Monsanto Ave.

Radio To be determined.

Other --

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Emergency Contacts

1. Mr. Raymond Harbison (University of Arkansas) (501) 661-5766 or 661-5767
(501) 370-8263 (24 hour)
2. Paul D. Moss, Regional Safety Coordinator/Chicago (312) 663-9415 (office)
(312) 541-6635 (home)
3. Ecology and Environment, Inc., Corporate Safety Director/
D. Dahlstrom (716) 632-4491 (office)
(716) 741-2384 (home)

Medtox Hotline

1. Twenty-four hour answering service - (501) 370-8263
What to Report:
 - State: "This is an emergency."
 - Your name, region, and site.
 - Telephone number to reach you.
 - Your location.
 - Name of person injured or exposed.
 - Nature of emergency.
 - Action taken.
2. One of three toxicologists (Drs. Raymond Harbison, Glenn Milner, or Robert James) will contact you. Repeat the information given to the answering service.
3. If a toxicologist does not return your call within 15 minutes, call the following persons in order until contact is made:
 - E & E Corporate Headquarters (EST 0830-1700) - (716) 632-4491
 - a. Twenty-four hour line - (716) 631-9530
 - b. Corporate Safety Director - David Dahlstrom (home - (716) 741-2384)
 - c. Assistant Corporate Safety Officer - Steve Sherman (home - (716) 688-0084)

Emergency Routes

Directions to Hospital (incl. MAP) Monsanto Ave. east to Monsanto Rd. (19th St. in E. St. Louis) north on 19th St. to Converse Ave. West on Converse Ave. to 15th St. North on 15th St. to King Drive. East on King Dr. to Christian Welfare Hospital. Routes to be driven by designated site personnel prior to initiating on-site operations.

Other To BI State Parks Airport: State Route 50 south to Judith Lane. East on Judith Lane to Cahokia Rd. South on Cahokia Rd. to Julian Ave. East on Julian Ave. to Airport Rd.

F. EQUIPMENT CHECKLIST

PROTECTIVE GEAR

LEVEL A

SCBA _____

SPARE AIR TANKS _____

ENCAPSULATED SUIT _____

SURGICAL GLOVES _____

NEOPRENE SAFETY BOOTS _____

BOOTIES _____

GLOVES (TYPE _____) _____

OUTER WORK GLOVES _____

HARD HAT _____

CASCADE SYSTEM _____

LEVEL C

ULTRA-TWIN RESPIRATOR _____ X

RACAL POWER AIR PURIFYING
RESPIRATOR _____ X

RACAL CARTRIDGES (TYPE
GMC-H AEP-3) _____ X

ROBERTSHAW ESCAPE MASK _____

CHEMICAL RESISTANT COVERALLS _____ X

PROTECTIVE COVERALL
(TYPE SARANAC (HOODED) _____) _____ X

RAIN SUIT _____ X

BUTYL APRON _____

SURGICAL GLOVES (LATEX) _____ X

GLOVES (TYPE VITON - NEOPRENE) _____ X

OUTER WORK GLOVES _____

NEOPRENE SAFETY BOOTS _____ X

HARD HAT WITH FACE SHIELD _____ X

LATEX DISPOSABLE BOOTIES _____ X

LEVEL B

SCBA _____ X

SPARE AIR TANKS _____ X

CHEMICAL RESISTANT COVERALLS _____ X

PROTECTIVE COVERALL
(TYPE SARANAC (HOODED) _____) _____ X

RAIN SUIT _____ X

BUTYL APRON _____

SURGICAL GLOVES _____ X

GLOVES (TYPE VITON _____) _____ X

OUTER WORK GLOVES _____

NEOPRENE SAFETY BOOTS _____ X

BOOTIES _____ X

HARD HAT WITH FACE SHIELD _____ X

CASCADE SYSTEM _____

MANIFOLD SYSTEM _____ X

AIR COMPRESSOR _____ X

LEVEL D

ULTRA-TWIN RESPIRATOR (AVAILABLE) _____ X

CARTRIDGES (TYPE GMC-H _____) _____ X

ROBERTSHAW ESCAPE MASK (AVAILABLE) _____

CHEMICAL RESISTANT COVERALLS _____ X

PROTECTIVE COVERALL
(TYPE TYVEK, SARANAC _____) _____ X

RAIN SUIT _____

NEOPRENE SAFETY BOOTS _____ X

BOOTIES (LATEX) _____ X

WORK GLOVES _____

HARD HAT WITH FACE SHIELD _____ X

SAFETY GLASSES _____ X

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INSTRUMENTATION

OVA	<u>X</u>
THERMAL DESORBER	<u> </u>
O2/EXPLOSIMETER	<u>X</u>
EXPLOSIMETER CALIBRATION KIT	<u>X</u>
HNU W/10-2 EV LAMP	<u>X</u>
VICTOREEN 471	<u> </u>
MAGNETOMETER	<u>X</u>
PIPE LOCATOR	<u> </u>
WEATHER STATION	<u>X</u>
DRAEGER PUMP	<u> </u>
BRUNTON COMPASS	<u> </u>
HNU CALIBRATION KIT	<u>X</u>
MONITOX CN METER	<u>X</u>
GCA/MDA PARTICULATE MONITOR	<u>X</u>

FIRST AID EQUIPMENT

FIRST AID KIT	<u>X</u>
OXYGEN ADMINISTRATOR	<u> </u>
STRECHER	<u> </u>
PORTABLE EYE WASH	<u>X</u>
BLOOD PRESSURE MONITOR	<u>X</u>
RADIATION BADGES	<u>X</u>
FIRE EXTINGUISHER	<u>X</u>
THERMOMETERS (OVAL)	<u>X</u>

DECON EQUIPMENT

WASH TUBS	<u>X</u>
BUCKETS	<u>X</u>
SCRUB BRUSHES	<u>X</u>
PRESSURIZED SPRAYER	<u>X</u>
DETERGENT (TYPE TSP <u> </u>)	<u>X</u>
SOLVENT (TYPE HEXANE <u> </u>)	<u>X</u>
ACETONE <u> </u>	<u>X</u>

DECON EQUIPMENT (CONT.)

PLASTIC SHEETING	<u>X</u>
TARPS	<u>X</u>
TRASH BAGS	<u>X</u>
TRASH CANS	<u> </u>
MASKING TAPE	<u>X</u>
DUCT TAPE	<u>X</u>
PAPER TOWELS	<u>X</u>
FACE MASK	<u> </u>
FACE MASK SANITIZER	<u>X</u>
FOLDING CHAIRS	<u>X</u>
STEP LADDERS	<u> </u>

SAMPLING EQUIPMENT

To be determined

ecology and environment, inc.

HAZARD EVALUATION OF CHEMICALS

Chemical Name 2,3,7,8 tetrachlorodibenzo- **Date** 10/8/85
DOT Name/U.N. No. None **Job No.** IL-3020
CAS Number 1746-01-6

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verachuren Merck Index **Hazardline** Chris (Vol. II)
Toxic and Hazardous Safety Manual ACGIH **Other:** RTECS

Chemical Properties: (Synonyms: Dioxin, TCDD)
Chemical Formula C₁₂H₄O₂Cl₄ **Molecular Weight** 322 sfw
Physical State Crystalline **Solubility (H₂O)** 0.2 **Boiling Point** Decomposes at >1292°F
Flash Point N/A **Vapor Pressure/Density** 1.7 x 10⁻⁶ **Freezing Point** N/A
Specific Gravity 1.075 @ 25°C **Odor/Odor Threshold** -- @ 770°F **Flammable Limits** N/A
Incompatibilities Unknown

Biological Properties:

TLV-TWA Not established **PEL** Not established **Odor Characteristic** --
IDLH 22,500 ng/kg **Human** -- **Aquatic** -- **Rat/Mouse** Oral LD₅₀ = 22 ug/kg
Route of Exposure Dermal, inhalation, ingestion
Carcinogen Suspected **Teratogen** Animal (RTECS) **Mutagen** Positive (RTECS)
EPA/CDC level in soil is 1 ppb

Handling Recommendations: (Personal protective measures)

Supplied air suggested, coated, chemically resistant coveralls,
butyl or neoprene boots and gloves. Avoid all contact with skin.

Monitoring Recommendations:

Monitor for dust in the air.

Disposal/Waste Treatment:

Remove from environment and store safely until an approved disposal
site can be located (store in sealed, non-reusable containers).

Health Hazards and First Aid: Eyes: Wash immediately with copious amounts of water.
Skin: Wash with soap or mild detergent and water. Inhalation: Remove to fresh air
(AR if necessary). Ingestion: Give water, then induce vomiting.

Symptoms: **Acute:** Chloracne, skin and eye irritation, fatigue, respiratory distress,
mental depression.
Chronic: Chloracne, hepatic neurosis, hemorrhage, emphysema, liver,
thyroid, skin, and kidney carcinogens. CNS depression.

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(12/83,3LD)

VAN EQUIPMENT

TOOL KIT
HYDRAULIC JACK
LUG WRENCH
TOW CHAIN
VAN CHECK OUT
GAS
OIL
ANTIFREEZE
BATTERY
WINDSHIELD WASH
TIRE PRESSURE

MISCELLANEOUS (CONT.)

BINOCULARS
MEGAPHONE

MISCELLANEOUS

PITCHER PUMP
SURVEYOR'S TAPE
100 FIBERGLASS TAPE
300 NYLON ROPE
NYLON STRING
SURVEYING FLAGS
FILM
WHEEL BARROW
BUNG WRENCH
SOIL AUGER
PICK
SHOVEL
CATALYTIC HEATER
PROPANE GAS
BANNER TAPE
SURVEYING METER STICK
CHAINING PINS & RING
TABLES
WEATHER RADIO

X

X

X

X

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HAZARDOUS & TOXIC MATERIALS TEAM
SITE SAFETY REVIEW

GENERAL INFORMATION

DATE _____ TIME _____ JOB NO: _____

SITE: _____

LOCATION: _____

ONSITE CLIENT CONTACT: _____

OBJECTIVES: _____

TYPES OF CHEMICALS ANTICIPATED: _____

MEETING CONDUCTED BY: _____

TOPICS DISCUSSED

PHYSICAL HAZARDS: _____

CHEMICAL HAZARDS: _____

PERSONAL PROTECTION: _____

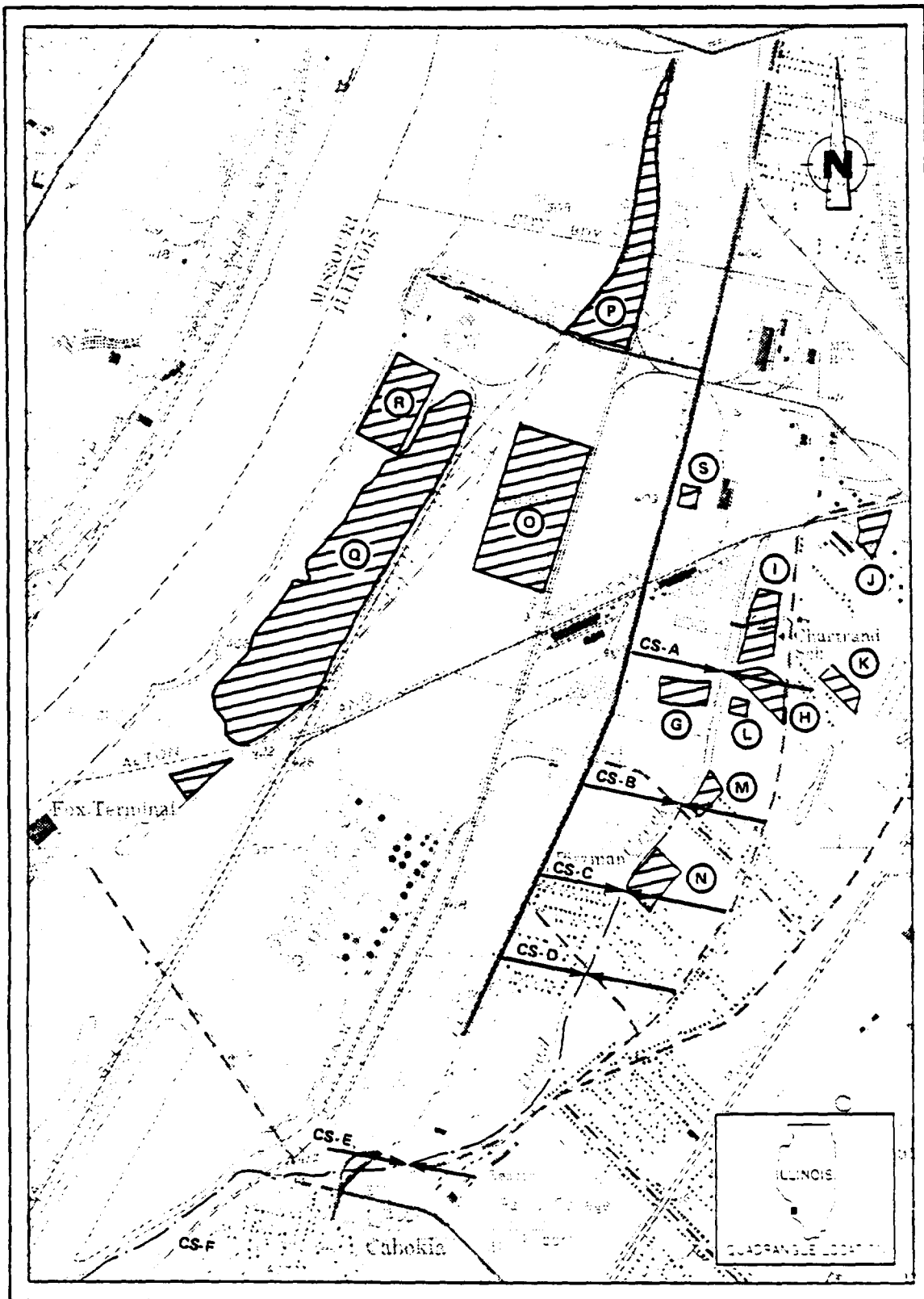
DECONTAMINATION: _____

SPECIAL SITE CONSIDERATIONS: _____

CHECK LIST

1. Emergency information reviewed? and made familiar to all team members?
2. Route to nearest hospital driven and its location known to all team?
3. Site safety plan readily available and its location known to all team members? _____

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DEAD CREEK PROJECT AREA SITE LOCATION MAP

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HAZARD EVALUATION OF CHEMICALS

Chemical Name _____ Date _____
DOT Name/U.M. No. _____ Job No. _____
CAS Number _____

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)
Toxic and Hazardous Safety Manual ACGIH Other: _____

Chemical Properties: (Synonyms: _____)

Chemical Formula _____ Molecular Weight _____
Physical State _____ Solubility (H₂O) _____ Boiling Point _____
Flash Point _____ Vapor Pressure/Density _____ Freezing Point _____
Specific Gravity _____ Odor/Odor Threshold _____ Flammable Limits _____
Incompatibilities _____

Biological Properties:

TLV-TWA _____ PEL _____ Odor Characteristic _____
IDLH _____ Human _____ Aquatic _____ Rat/Mouse _____
Route of Exposure _____
Carcinogen _____ Teratogen _____ Mutagen _____

Handling Recommendations: (Personal protective measures)

Monitoring Recommendations:

Disposal/Waste Treatment:



Health Hazards and First Aid:

Symptoms: Acute: _____
 Chronic: _____

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(12/83,JLD)

AST

ARSENIC TRICHLORIDE

Common Synonyms Fuming liquid arsenic Arsenic (III) trichloride Arsenic chloride Arsenous chloride Chlorine arsenic chloride		Liquid Risks and reacts in water. Poisonous volatile vapor cloud is produced	Colorless Unpleasant odor
AVOID CONTACT WITH LIQUID AND VAPOR. KEEP PEOPLE AWAY. Wear goggles and self-contained breathing apparatus. Stop discharge if possible. Isolate and remove discharged material. Notify local health and pollution control agencies.			
Fire	Not Flammable POISONOUS GASES ARE PRODUCED WHEN HEATED		
	CALL FOR MEDICAL AID VAPOR POISONOUS IF INHALED. Move victim to fresh air. If breathing is difficult, give oxygen. LIQUID POISONOUS IF SWALLOWED. Irritating to skin and eyes. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.		
Exposure			
Water Pollution	Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water bodies. Notify local health and wildlife officials. Notify agencies of nearby water bodies.		
1. RESPONSE TO DISCHARGE Also Review Status Section, CG 445-3 Issue warning - poison, water Contaminant, corrosive Restrict access Disperse and flush		2. LABEL 	
3. CHEMICAL DESIGNATIONS 3.1 Synonyms: Arsenic (III) trichloride. Arsenic chloride, Arsenous chloride. Arsenous chloride, Better of arsenic Caustic arsenic chloride, Caustic oil of arsenic, Fuming liquid arsenic 3.2 Coast Guard Compatibility Classification: Not applicable 3.3 Chemical Formula: AsCl ₃ 3.4 NRCO/United Nations Hazardous Designation: 6.1/1540		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Acrid	
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Safety goggles and face shield, acid-type canister gas mask, rubber gloves, protective clothing 5.2 Symptoms Following Exposure: Inhalation causes irritation of nose and throat. Contact of liquid with eyes or skin causes severe irritation. Ingestion causes weakness and severe irritation of mouth and stomach. Overdose can cause arsenic poisoning, but symptoms are delayed 5.3 Treatment for Exposure: Get medical attention after all exposures to the compound. Be alert for arsenic poisoning symptoms. INHALATION: remove to fresh air, give artificial respiration if needed. EYES: Flush with water for at least 15 min. SKIN: Flush with water. INGESTION: give large amounts of water, then induce vomiting, give lime water, milk, or raw egg, give a cathartic. 5.4 Toxicity by Inhalation (Threshold Limit Value): 0.5 mg/m ³ as arsenic 5.5 Short-Term Inhalation Limits: Data not available 5.6 Toxicity by Ingestion: Grade 3, oral rat LD ₅₀ = 138 mg/kg, fatal human dose 70-180 mg, depending on weight 5.7 Late Toxicity: Arsenic compounds may be carcinogenic 5.8 Vapor (Gas) Irritant Characteristics: Data not available 5.9 Liquid or Solid Irritant Characteristics: Data not available 5.10 Odor Threshold: Data not available			

6. FIRE HAZARDS 6.1 Flash Point: Not flammable 6.2 Flammable Limits in Air: Not flammable 6.3 Fire Extinguishing Agents: Not pertinent 6.4 Fire Extinguishing Agents Not to be Used: Avoid water on adjacent fires 6.5 Special Hazards of Combustion Products: Irritating and toxic hydrogen chloride formed when involved in fire 6.6 Behavior in Fire: Becomes gaseous and causes irritation. Forms hydrogen chloride (hydrochloric acid) by reaction with water used on adjacent fires 6.7 Ignition Temperature: Not pertinent 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Not pertinent		8. WATER POLLUTION 8.1 Aquatic Toxicity: Data not available 8.2 Waterborne Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: None	
7. CHEMICAL REACTIVITY 7.1 Reactivity with Water: Reacts with water to generate hydrogen chloride (hydrochloric acid) 7.2 Reactivity with Common Materials: Corrodes metal 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Flush with water, rinse with sodium bicarbonate or lime solution 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent		9. SELECTED MANUFACTURERS 1 Cerac, Inc. 13460 W. Silver Spring Rd. Menomonee Falls, Wis. 53051 2 Verson Corporation Alfa Products P. O. Box 159 Beverly, Mass. 01915 3 Gallard Schlesinger Chemical Manufacturing Co. 584 Mineola Avenue Carle Place, N. Y. 11514	
11. HAZARD ASSESSMENT CODE <small>(See Hazard Assessment Handbook, CG 445-3)</small> A-O		10. SHIPPING INFORMATION 10.1 Grades or Purities: Commercial 10.2 Storage Temperature: Ambient 10.3 Inert Atmosphere: No requirement 10.4 Venting: Pressure-vacuum	
12. HAZARD CLASSIFICATIONS 12.1 Code of Federal Regulations: Poisonous, Class B 12.2 IAS Hazard Rating for Bulk Water Transportation: Not listed 12.3 HPPA Hazard Classifications: Not listed		13. PHYSICAL AND CHEMICAL PROPERTIES 13.1 Physical State at 18°C and 1 atm: Liquid 13.2 Molecular Weight: 181.3 13.3 Boiling Point at 1 atm: 266.4°F = 130.2°C = 403.4°K 13.4 Freezing Point: 9°F = -13°C = 260°K 13.5 Critical Temperature: Not pertinent 13.6 Critical Pressure: Not pertinent 13.7 Specific Gravity: 2.156 at 25°C (liquid) 13.8 Liquid Surface Tension: (est.) 20 dynes/cm = 0.020 N/m at 20°C 13.9 Liquid-Water Interfacial Tension: Not pertinent 13.10 Vapor (Gas) Specific Gravity: Not pertinent 13.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 13.12 Latent Heat of Vaporization: 88.31 Btu/lb = 49.06 cal/g = 2.054 × 10 ⁴ J/kg 13.13 Heat of Combustion: Not pertinent 13.14 Heat of Decomposition: Not pertinent 13.15 Heat of Solution: (est.) -18 Btu/lb = -10 cal/g = -0.42 × 10 ⁴ J/kg 13.16 Heat of Polymerization: Not pertinent	
<i>(Continued on pages 5 and 6)</i>			
NOTES			

P-CHLOROTOLUENE

COMMON SYNONYMS <p>p-Tolyl chloride 4-Chloro-1-methylbenzene 4-Chlorotoluene</p>	<p>Liquid</p> <p>Colorless</p> <p>Sinks slowly in water</p>
<p>Avoid contact with liquid. Keep people away from goggles and self-contained breathing apparatus. Stop discharge if possible. Call fire department. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>	
FIRE	<p>COMBUSTIBLE</p> <p>Wear goggles and self-contained breathing apparatus. Extinguish with alcohol foam, carbon dioxide or dry chemical.</p>
EXPOSURE	<p>CALL FOR MEDICAL AID</p> <p>LIQUID</p> <p>Irritating to skin and eyes. Harmful if swallowed.</p> <p>Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES: hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS: have victim drink water or milk and induce vomiting.</p>
WATER POLLUTION	<p>HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS</p> <p>May be dangerous if it enters water bodies.</p> <p>Notify local health and wildlife officials. Notify operators of nearby water intakes.</p>

<p>1. RESPONSE TO DISCHARGE</p> <p>See Response Manual Handbook, CG 400-4</p> <p>Restrict access. Chemical and physical treatment. Dampen and flush.</p>	<p>2. LABELS</p> <p>No hazard label required by Code of Federal Regulations</p>
<p>3. CHEMICAL DESIGNATIONS</p> <p>3.1 SYNONYMS: 4-Chloro-1-methylbenzene; p-Tolyl chloride; 1-Chloro-4-methylbenzene</p> <p>3.2 COAST GUARD COMPATIBILITY CLASSIFICATION: Halogenated compound</p> <p>3.3 CHEMICAL FORMULA: C_7H_7Cl</p> <p>3.4 UNIFORMED NATIONS NUMERICAL DESIGNATION: Not listed</p>	<p>4. OBSERVABLE CHARACTERISTICS</p> <p>4.1 PHYSICAL STATE (AS SHIPPED): Liquid</p> <p>4.2 COLOR: Colorless</p> <p>4.3 ODOR: Characteristic</p>

<p>5. HEALTH HAZARDS</p> <p>5.1 PERSONAL PROTECTIVE EQUIPMENT: Respirator with proper filter; goggles</p> <p>5.2 SYMPTOMS FOLLOWING EXPOSURE: INHALATION: Irritation of respiratory system. EYES AND SKIN: Severe irritation. INGESTION: Severe internal damage if swallowed</p> <p>5.3 TREATMENT FOR EXPOSURE: Get medical aid. INHALATION: Move to fresh air. Remove contaminated clothing. Keep warm and quiet. If breathing has stopped give artificial respiration. EYES AND SKIN: Flush with plenty of water. INGESTION: Give one or two glasses of water or milk. Induce vomiting. Give emetics.</p> <p>5.4 TOXICITY BY INHALATION (THRESHOLD LIMIT VALUE): Data not available.</p> <p>5.5 SHORT TERM INHALATION LIMITS: Data not available</p> <p>5.6 TOXICITY BY INGESTION: Data not available</p> <p>5.7 LATE TOXICITY: Data not available</p> <p>5.8 VAPOR (GAS) IRRITANT CHARACTERISTICS: Data not available</p> <p>5.9 LIQUID OR SOLID IRRITANT CHARACTERISTICS: Data not available.</p> <p>5.10 ODOR THRESHOLD: Data not available</p>

<p>6. FIRE HAZARDS</p> <p>6.1 FLASH POINT: Data not available</p> <p>6.2 FLAMMABLE LIMITS IN AIR: Data not available</p> <p>6.3 FIRE EXTINGUISHING AGENTS: Alcohol foam, CO_2, Dry chemical</p> <p>6.4 FIRE EXTINGUISHING AGENTS NOT TO BE USED: Data not available</p> <p>6.5 SPECIAL HAZARDS OF COMBUSTION PRODUCTS: Data not available</p> <p>6.6 BEHAVIOR IN FIRE: Not pertinent</p> <p>6.7 IGNITION TEMPERATURE: Data not available</p> <p>6.8 ELECTRICAL HAZARD: Data not available</p> <p>6.9 BURNING RATE: Data not available</p>

<p>8. WATER POLLUTION</p> <p>8.1 AQUATIC TOXICITY: 1-10 ppm/96 hour/Fish/L₅₀</p> <p>8.2 WATERFOWL TOXICITY: Data not available</p> <p>8.3 BIOLOGICAL OXYGEN DEMAND (BOD): Data not available</p> <p>8.4 FOOD CHAIN CONCENTRATION POTENTIAL: Data not available</p>
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<p>7. CHEMICAL REACTIVITY</p> <p>7.1 REACTIVITY WITH WATER: Data not available</p> <p>7.2 REACTIVITY WITH COMMON MATERIALS: Data not available</p> <p>7.3 STABILITY DURING TRANSPORT: Data not available</p> <p>7.4 NEUTRALIZING AGENTS FOR ACIDS AND CAUSTICS: Data not available</p> <p>7.5 POLYMERIZATION: Data not available</p> <p>7.6 INHIBITOR OF POLYMERIZATION: Data not available</p>
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<p>9. SELECTED MANUFACTURERS</p> <p>1. American Hoechst Corporation Industrial Chemicals Division Organic Intermediates Department Route 202-206 N. Somerville, NJ 08876</p> <p>2. Tennessee Chemicals, Inc. Turner Pl. P. O. Box 305 Pascagoula, NJ 08854</p>

<p>11. HAZARD ASSESSMENT CODE</p> <p>See Hazard Assessment Handbook, CG 400-3</p> <p>AX</p>
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<p>10. SHIPPING INFORMATION</p> <p>10.1 GRADES OR PURITY: Data not available</p> <p>10.2 STORAGE TEMPERATURE: Data not available</p> <p>10.3 INERT ATMOSPHERE: Data not available</p> <p>10.4 VENTING: Data not available</p>
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<p>12. HAZARD CLASSIFICATIONS</p> <p>12.1 CODE OF FEDERAL REGULATIONS: Not listed</p> <p>12.2 NAE HAZARD RATING FOR BULK WATER TRANSPORTATION: Not listed</p> <p>12.3 NFPA HAZARD CLASSIFICATIONS</p> <table><tr><th>Category</th><th>Classification</th></tr><tr><td>Health Hazard (Blue)</td><td>3</td></tr><tr><td>Flammability (Red)</td><td>2</td></tr><tr><td>Reactivity (Yellow)</td><td>0</td></tr></table>	Category	Classification	Health Hazard (Blue)	3	Flammability (Red)	2	Reactivity (Yellow)	0
Category	Classification							
Health Hazard (Blue)	3							
Flammability (Red)	2							
Reactivity (Yellow)	0							

<p>13. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>13.1 PHYSICAL STATE AT 15°C AND 1 ATM: Liquid</p> <p>13.2 MOLECULAR WEIGHT: 126.6</p> <p>13.3 BOILING POINT AT 1 ATM: 154°F = 68°C = 435.2°K</p> <p>13.4 FREEZING POINT: 46.5°F = 7.5°C = 280.7°K</p> <p>13.5 CRITICAL TEMPERATURE: Data not available</p> <p>13.6 CRITICAL PRESSURE: Data not available</p> <p>13.7 SPECIFIC GRAVITY: 1.0897 at 20°C</p> <p>13.8 LIQUID SURFACE TENSION: 32.24 dynes/cm = 0.03224 N/m at 25°C</p> <p>13.9 LIQUID-WATER INTERFACIAL TENSION: Data not available</p> <p>13.10 VAPOR (GAS) SPECIFIC GRAVITY: 4.36 (estimated)</p> <p>13.11 RATIO OF SPECIFIC HEATS OF VAPOR (GAS): Data not available</p> <p>13.12 LATENT HEAT OF VAPORIZATION: At boiling point: 136.8 Btu/lb = 76 cal/g = 3.18 x 10⁵ J/kg</p> <p>13.13 HEAT OF COMBUSTION: Data not available</p> <p>13.14 HEAT OF DECOMPOSITION: Data not available</p> <p>13.15 HEAT OF SOLUTION: Not pertinent</p> <p>13.16 HEAT OF POLYMERIZATION: Data not available</p>
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<p>NOTES</p>

o-DICHLOROBENZENE

Chemical Names 1,2-Dichlorobenzene Orthodichlorobenzene	Liquid Colorless Pleasant odor Insoluble in water																												
Avoid contact with liquid. Wear goggles and self-contained breathing apparatus. Stop discharge if possible. Call fire department. Isolate and remove discharged material. Notify local health and pollution control agencies.																													
Fire	Combustible POISONOUS GASES ARE PRODUCED IN FIRE. Wear goggles and self-contained breathing apparatus. Extinguish with water, dry chemical, foam, or carbon dioxide. Cool exposed containers with water.																												
Exposure	CALL FOR MEDICAL AID LIQUID Irritating to skin and eyes. Slightly if swallowed. Remove contaminated clothing and shoes. Flush affected area with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.																												
Water Pollution	Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water streams. Notify local health and pollution control officials. Notify agencies of nearby water bodies.																												
1. RESPONSE TO DISCHARGE Use Response Methods Worksheet, DB 448-4. Issue warning — water contamination. Should be removed. Chemical and physical treatment.																													
2. LABELS No hazard label required by Code of Federal Regulations.																													
3. CHEMICAL DESIGNATIONS 3.1 Synonyms: 1,2-Dichlorobenzene Dowtherm E Orthodichlorobenzene 3.2 Control Group Compatibility Classification: Halogenated hydrocarbons 3.3 Chemical Formula: $\text{C}_6\text{H}_4\text{Cl}_2$ 3.4 EPCO/United Nations Hazardous Designation: 6.1(159)	4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Aromatic; characteristic aromatic																												
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Organic vapor-acid gas respirator, neoprene or vinyl gloves, chemical safety spectacles, face shield, rubber foot wear, apron, protective clothing. 5.2 Symptoms Following Exposure: Chronic inhalation of mist or vapors may result in damage to lungs, liver, and kidneys. Acute vapor exposure can cause symptoms ranging from coughing to central nervous system depression and transient anesthesia. Irritating to skin, eyes, and mucous membranes. May cause dermatitis. 5.3 Treatment for Exposure: INHALATION: remove victim to fresh air, keep him quiet and warm and call a physician promptly. INGESTION: no known antidote. Treat symptomatically, induce vomiting and get medical attention promptly. EYES AND SKIN: flush with plenty of water, get medical attention for eyes, remove contaminated clothing and wash before reuse. 5.4 Toxicity by Inhalation (Threshold Limit Value): 50 ppm 5.5 Short-Term Inhalation Limit: 50 ppm for 15 min 5.6 Toxicity by Ingestion: Grade 2, LD ₅₀ 0.5 to 5 g/kg 5.7 Lethal Toxicity: Causes injury and liver damage in rats. Effects unknown in humans. 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will feel high concentrations unpleasant. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin. 5.10 Odor Threshold: 4.0 ppm, 50 ppm																													
6. FIRE HAZARDS 6.1 Flash Point: 165°F O.C., 155°F C.C. 6.2 Flammable Limits in Air: 2.2% — 9.2% 6.3 Fire Extinguishing Agents: Water, foam, dry chemical, or carbon dioxide. 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent. 6.5 Special Hazards of Combustion Products: Irritating vapors including hydrogen chloride gas, chloroacarbon, chlorine. 6.6 Behavior in Fire: Not pertinent. 6.7 Ignition Temperature: 1190°F 6.8 Electrical Hazard: Not pertinent. 6.9 Burning Rate: 1.3 mm/min																													
7. CHEMICAL REACTIVITY 7.1 Reactivity with Water: No reaction. 7.2 Reactivity with Common Materials: No reaction. 7.3 Stability During Transport: Stable. 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent. 7.5 Polymerization: Not pertinent. 7.6 Inhibitor of Polymerization: Not pertinent.																													
11. HAZARD ASSESSMENT CODE Use Hazard Assessment Worksheet, DB 448-2. A-X-Y																													
12. HAZARD CLASSIFICATIONS 12.1 Code of Federal Regulations: ORM-A 12.2 IAS Hazard Rating for Bulk Water Transportation: <table data-bbox="933 1438 1181 1715"> <thead> <tr> <th>Category</th><th>Rating</th></tr> </thead> <tbody> <tr> <td>Fire</td><td>1</td></tr> <tr> <td>Health</td><td></td></tr> <tr> <td> Vapor Irritant</td><td>2</td></tr> <tr> <td> Liquid or Solid Irritant</td><td>1</td></tr> <tr> <td> Poison</td><td>1</td></tr> <tr> <td>Water Pollution</td><td></td></tr> <tr> <td> Human Toxicity</td><td>1</td></tr> <tr> <td> Aquatic Toxicity</td><td>3</td></tr> <tr> <td> Aesthetic Effect</td><td>2</td></tr> <tr> <td>Reactivity</td><td></td></tr> <tr> <td> Other Chemicals</td><td>1</td></tr> <tr> <td> Water</td><td>0</td></tr> <tr> <td> Self-Reaction</td><td>0</td></tr> </tbody> </table>		Category	Rating	Fire	1	Health		Vapor Irritant	2	Liquid or Solid Irritant	1	Poison	1	Water Pollution		Human Toxicity	1	Aquatic Toxicity	3	Aesthetic Effect	2	Reactivity		Other Chemicals	1	Water	0	Self-Reaction	0
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12.3 GPPA Hazard Classifications: <table data-bbox="933 1885 1181 1949"> <thead> <tr> <th>Category</th><th>Classification</th></tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td><td>2</td></tr> <tr> <td>Flammability (Red)</td><td>2</td></tr> <tr> <td>Reactivity (Yellow)</td><td>0</td></tr> </tbody> </table>		Category	Classification	Health Hazard (Blue)	2	Flammability (Red)	2	Reactivity (Yellow)	0																				
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Reactivity (Yellow)	0																												
8. WATER POLLUTION 8.1 Aquatic Toxicity: 13 ppm/l (marine plankton/no growth / soft water) *Time period not specified 8.2 Waterborne Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): <0.1% (over 1, 1/3 day) 8.4 Food Chain Concentration Potential: Data not available																													
9. SELECTED MANUFACTURERS 1 Dow Chemical Co Midland, Mich 48640 2 Monsanto Co Monsanto Industrial Chemicals Co 800 North Lindbergh Blvd St. Louis, Mo 63166 3 Standard Chlorine Chemical Co., Inc. 1015-25 Bellevue Turnpike Kearney, N. J. 07032																													
10. SHIPPING INFORMATION 10.1 Grades or Purities: Technical 99.5% min. dichlorobenzene (ortho-ortho + para/meta 80 min.) Technical 85% orthodichlorobenzene, 14.0% para-dichlorobenzene Technical 80% ortho, 17% para, 2% meta Pure not less than 99.5% ortho, not more than 0.5% para 10.2 Storage Temperature: Data not available (Continued on page 4)																													
13. PHYSICAL AND CHEMICAL PROPERTIES 13.1 Physical State at 18°C and 1 atm: Liquid 13.2 Molecular Weight: 147.01 13.3 Boiling Point at 1 atm: 334.9°F = 168.3°C = 453.7°K 13.4 Freezing Point: 0.3°F = -17.6°C = 255.6°K 13.5 Critical Temperature: Not pertinent 13.6 Critical Pressure: Not pertinent 13.7 Specific Gravity: 1.304 at 20°C (liquid) 13.8 Liquid Surface Tension: 37 dynes/cm = 0.037 N/m at 20°C 13.9 Liquid-Water Interfacial Tension: (est.) 40 dynes/cm = 0.04 N/m at 20°C 13.10 Vapor (Gas) Specific Gravity: Not pertinent 13.11 Ratio of Specific Heats of Vapor (Gas): 1.080 13.12 Latent Heat of Vaporization: 115 Btu/lb = 63.9 cal/g = 2.68×10^3 J/kg 13.13 Heat of Combustion: -7969 Btu/lb = -4627 cal/g = -185.4×10^3 J/kg 13.14 Heat of Decomposition: Not pertinent 13.15 Heat of Solution: Not pertinent 13.16 Heat of Polymerization: Not pertinent																													
18. SHIPPING INFORMATION (Cont'd.) 10.3 Inert Atmosphere: Data not available 10.4 Venting: Data not available																													

DCP


2,4-DICHLOROPHENOL

Common Synonyms		Solid crystals	Colorless	Medicinal odor
		Soluble in water		
Avoid contact with solid and dust. Keep people away. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Call for drycleaning. Isolate and remove discharged material. Notify local health and pollution control agencies.				
Fire	Combustible POISONOUS GASES ARE PRODUCED IN FIRE Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Extinguish with dry chemical foam, or carbon dioxide. Cool exposed containers with water.			
 Exposure	CALL FOR MEDICAL AID SOLID OR DUST Will burn skin and eyes. Pain from if swallowed. Remove contaminated clothing and shoes. Flush affected area with plenty of water. IF IN EYES: hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.			
Water Pollution	Effect of low concentrations on aquatic life is unknown. May be dangerous if a massive spill occurs. Notify local health and wildlife officials. Notify operators of nearby water bodies.			
1. RESPONSE TO DISCHARGE (See Response Methods Handbook, CG-445-1) Isolate, remove, water containment. Should be removed. Chemical and physical treatment.		2. LABELS No hazard label required by Code of Federal Regulations.		
3. CHEMICAL DESIGNATIONS 3.1 Synonyms: No common synonyms. 3.2 Coast Guard Compatibility Classification: Not applicable. 3.3 Chemical Formula: HOCH ₂ Cl-2,4 3.4 MSD/United Nations Hazardous Designation: 6.1 (202)		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Solid 4.2 Color: White 4.3 Odor: Strong medicinal		
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Bureau of Mines approved respirator, rubber gloves, chemical goggles. 5.2 Symptoms Following Exposure: Tremors, convulsions, shortness of breath, inhibition of respiratory system. 5.3 Treatment for Exposure: Inhalation — rest, ingestion — drink water, special salt solution. 5.4 Toxicity by Inhalation (Threshold Limit Value): Not pertinent. 5.5 Short-Term Inhalation Limit: Data not available. 5.6 Toxicity by Ingestion: Grade 2, LD ₅₀ 0.5 to 2 g/kg (rat). 5.7 Lethal Toxicity: Data not available. 5.8 Vapor (Gas) Irritant Characteristics: Not pertinent. 5.9 Liquid or Solid Irritant Characteristics: Fairly severe skin irritant. May cause pain and second-degree burns after a few minutes' contact. 5.10 Oral Threshold: Data not available.				

<p>6. FIRE HAZARDS</p> <p>6.1 Flash Point: 200°F O.C. 237°F C.C.</p> <p>6.2 Flammable Limits in Air: Data not available</p> <p>6.3 Fire Extinguishing Agents: Water, foam, carbon dioxide, dry chemical</p> <p>6.4 Fire Extinguishing Agents Not to be Used: Water or foam may cause frothing</p> <p>6.5 Special Hazards of Combustion Products: Toxic gases can be evolved</p> <p>6.6 Behavior in Fire: Solid melts and burns</p> <p>6.7 Ignition Temperature: Data not available</p> <p>6.8 Electrical Hazard: Not pertinent</p> <p>6.9 Burning Rate: Not pertinent</p>	<p>8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: 5 ppm/3 hours/rainbow trout/L500/fresh-water 5 ppm/12 hours/bluegill/L500/fresh-water</p> <p>8.2 Waterfowl Toxicity: Data not available</p> <p>8.3 Biological Oxygen Demand (BOD): 100% 3 days</p> <p>8.4 Food Chain Concentration Potential: Data not available</p>
<p>7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity with Water: No reaction</p> <p>7.2 Reactivity with Common Materials: May react vigorously with oxidizing materials</p> <p>7.3 Stability During Transport: Stable</p> <p>7.4 Neutralizing Agents for Acids and Caustics: Not pertinent</p> <p>7.5 Polymerization: Not pertinent</p> <p>7.6 Inhibitor of Polymerization: Not pertinent</p>	<p>9. SELECTED MANUFACTURERS</p> <p>1 Dow Chemical Co Midland Mich 48040</p> <p>2 Monsanto Co Monsanto Industrial Chemical Co 800 North Lindbergh Blvd St Louis Mo 63166</p> <p>10. SHIPPING INFORMATION</p> <p>10.1 Grades or Purities: Data not available</p> <p>10.2 Storage Temperature: Data not available</p> <p>10.3 Inert Atmosphere: Data not available</p> <p>10.4 Venting: Data not available</p>
<p>11. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook, CG-445-2) 11</p> <p>12. HAZARD CLASSIFICATIONS</p> <p>12.1 Code of Federal Regulations: Not listed</p> <p>12.2 IAS Hazard Rating for Bulk Water Transportation: Not listed</p> <p>12.3 IUPAC Hazard Classifications: Not listed</p>	<p>13. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>13.1 Physical State at 15°C and 1 atm: Solid</p> <p>13.2 Molecular Weight: 163.01</p> <p>13.3 Boiling Point at 1 atm: 421°F = 216°C = 489°K</p> <p>13.4 Freezing Point: 110°F = 45°C = 318°K</p> <p>13.5 Critical Temperature: Not pertinent</p> <p>13.6 Critical Pressure: Not pertinent</p> <p>13.7 Specific Gravity: 1.40 at 15°C (solid)</p> <p>13.8 Liquid Surface Tension: Not pertinent</p> <p>13.9 Liquid-Vapor Interfacial Tension: Not pertinent</p> <p>13.10 Vapor (Gas) Specific Gravity: Not pertinent</p> <p>13.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent</p> <p>13.12 Latent Heat of Vaporization: Not pertinent</p> <p>13.13 Heat of Combustion: Not pertinent</p> <p>13.14 Heat of Decomposition: Not pertinent</p> <p>13.15 Heat of Solution: Not pertinent</p> <p>13.16 Heat of Polymerization: Not pertinent</p>
<p align="center">NOTES</p> <p align="right">(Continued on page 1 and 6)</p>	

PCP

PENTACHLOROPHENOL

Common Synonyms Benzene 7 Pecca Samapex 20	Solid beads or flakes. White to light brown. Soluble in water.
Avoid contact with acid and dust. Keep people away from pipes and self-contained breathing apparatus. Stop discharge if possible. Isolate and remove discharged material. Notify local health and pollution control agencies.	
Fire	Not flammable
 Exposure	CALL FOR MEDICAL AID DUST Irritating to eyes, nose and throat. If inhaled, will cause coughing or difficult breathing. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. SOLID POISONOUS IF SWALLOWED Will burn skin and eyes. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES , hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify agencies of nearby water intakes.
1. RESPONSE TO DISCHARGE <small>(See Response Methods Handbook, CG 445-1)</small> Issue warning - poison. Restrict access. Should be removed.	2. LABELS No hazard label required by Code of Federal Regulations.
1. CHEMICAL DESIGNATIONS 3.1 Synonyms: Benzene 7 Pecca Samapex 20 3.2 Coast Guard Compatibility Classification: Not applicable 3.3 Chemical Formula: <chem>C6Cl5OH</chem> 3.4 MSD's United Nations Hazardous Designation: 6.1/20/20	4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Solid 4.2 Color: Colorless to light brown 4.3 Odor: Very weak
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Respirator for dust, goggles, protective clothing. 5.2 Symptoms Following Exposure: Dust or vapor irritates skin and mucous membranes, causing coughing and sneezing. Ingestion causes loss of appetite, respiratory difficulties, drowsiness, vomiting, coma. Overexposure can cause death. 5.3 Treatment for Exposure: Call a doctor! INGESTION : induce vomiting at once. EYES : Flush with water for 15-30 min. SKIN : wash well with soap and water. 5.4 Toxicity by Inhalation (Threshold Limit Value): 0.5 mg/m ³ 5.5 Short-Term Inhalation Limit: Data not available. 5.6 Toxicity by Ingestion: Grade 3, LD ₅₀ 50 to 500 mg/kg (rat). 5.7 Lethal Toxicity: Data not available. 5.8 Vapor (Gas) Irritant Characteristics: Vapor is moderately irritating such that personnel will not usually tolerate moderate or high vapor concentrations. 5.9 Liquid or Solid Irritant Characteristics: Causes smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure. 5.10 Odor Threshold: Data not available.	

6. FIRE HAZARDS 6.1 Flash Point: Not flammable. 6.2 Flammable Limits in Air: Not flammable. 6.3 Fire Extinguishing Agents: Not pertinent. 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent. 6.5 Special Hazards of Combustion Products: Generates toxic and irritating vapors. 6.6 Behavior in Fire: Not pertinent. 6.7 Ignition Temperature: Not flammable. 6.8 Electrical Hazard: Not pertinent. 6.9 Burning Rate: Not flammable.	8. WATER POLLUTION 8.1 Aquatic Toxicity: 5 ppm/3 hr/fresh water/lethal/fresh water. 8.2 Waterlevel Toxicity: 4500 ppm/LC50/mollusks. 8.3 Biological Oxygen Demand (BOD): Data not available. 8.4 Food Chain Concentration Potential: Data not available.								
7. CHEMICAL REACTIVITY 7.1 Reactivity with Water: No reaction. 7.2 Reactivity with Common Materials: No reaction. 7.3 Stability During Transport: Stable. 7.4 Neutralizing Agents for Acids and Bases: Not pertinent. 7.5 Polymerization: Not pertinent. 7.6 Inhibitor of Polymerization: Not pertinent.	9. SELECTED MANUFACTURERS 1. Dow Chemical Co. Midland, Mich. 48640 2. Reschold Chemicals, Inc. RCI Bldg. White Plains, N.Y. 10602 3. Sonford Chemical Co. Port Neches, Tex. 77651								
11. HAZARD ASSESSMENT CODE <small>(See Hazard Assessment Handbook, CG 445-3)</small> 11	10. SHIPPING INFORMATION 10.1 Grades or Purity: 54-100% 10.2 Storage Temperature: Ambient. 10.3 Inert Atmosphere: No requirement. 10.4 Venting: Open.								
12. HAZARD CLASSIFICATIONS 12.1 Code of Federal Regulations: Not listed. 12.2 IAS Hazard Rating for Bulk Water Transportation: Not listed. 12.3 NFPA Hazard Classifications: <table data-bbox="974 1470 1234 1564"> <thead> <tr> <th>Category</th><th>Classification</th></tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td><td>3</td></tr> <tr> <td>Flammability (Red)</td><td>0</td></tr> <tr> <td>Reactivity (Yellow)</td><td>0</td></tr> </tbody> </table>	Category	Classification	Health Hazard (Blue)	3	Flammability (Red)	0	Reactivity (Yellow)	0	13. PHYSICAL AND CHEMICAL PROPERTIES 13.1 Physical State at 18°C and 1 atm: Solid. 13.2 Molecular Weight: 266.35. 13.3 Boiling Point at 1 atm: 590°F = 310°C = 583°K. 13.4 Freezing Point: 370°F = 188°C = 461°K. 13.5 Critical Temperature: Not pertinent. 13.6 Critical Pressure: Not pertinent. 13.7 Specific Gravity: 1.96 at 15°C (solid). 13.8 Liquid Surface Tension: Not pertinent. 13.9 Liquid-Water Interfacial Tension: Not pertinent. 13.10 Vapor (Gas) Specific Gravity: Not pertinent. 13.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent. 13.12 Latent Heat of Vaporization: Not pertinent. 13.13 Heat of Combustion: Not pertinent. 13.14 Heat of Decomposition: Not pertinent. 13.15 Heat of Solution: Not pertinent. 13.16 Heat of Polymerization: Not pertinent.
Category	Classification								
Health Hazard (Blue)	3								
Flammability (Red)	0								
Reactivity (Yellow)	0								
NOTES <small>(Continued on pages 1 and 2)</small>									

PCB

POLYCHLORINATED BIPHENYL



Common Synonyms: PCB Chlorinated biphenyl Aroclor		Only liquid to solid powder Light yellow liquid or white powder Weak odor Residue on touch
Stop discharge if possible. Keep people away. Avoid contact with liquid and solid. Call fire department. Isolate and remove discharged material. Notify local health and pollution control agencies.		
Fire	Combustible Extinguish with water, foam, dry chemical, or carbon dioxide	
Exposure	CALL FOR MEDICAL AID LIQUID OR SOLID Irritating to skin and eyes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water.	
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.	
1. RESPONSE TO DISCHARGE See Response Material Manual, CB 445-4. Is not flammable - water contamination. Should be removed. Chemical and physical treatment.		2. LABELS No hazard label required by Code of Federal Regulations.
3. CHEMICAL DESIGNATIONS 3.1 Synonyms: Aroclor Chlorinated biphenyl; Halogenated bases; PCB; Polychlorophenyls. 3.2 Coast Guard Compatibility Classification: Not applicable. 3.3 Chemical Formula: $(C_{12}H_{10-4}Cl_4)$ 3.4 INCO/United Nations Hazardous Designation: Not listed.		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid or solid. 4.2 Color: Pale yellow (liquid); colorless (solid). 4.3 Odor: Practically odorless.
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Gloves and protective garments. 5.2 Symptoms Following Exposure: Acne from skin contact. 5.3 Treatment for Exposure: SKIN: wash with soap and water. 5.4 Toxicity by Inhalation (Threshold Limit Value): 0.5 to 1.0 mg/m ³ . 5.5 Short-Term Inhalation Limits: Data not available. 5.6 Toxicity by Ingestion: Grade 2; oral rat LD ₅₀ = 3900 mg/kg. 5.7 Late Toxicity: Causes chromosomal abnormalities in rats, birth defects in birds. 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause severe irritation of eyes and throat and cause eye and lung injury. They cannot be tolerated even at low concentrations. 5.9 Liquid or Solid Irritant Characteristics: Contact with skin may cause irritation. 5.10 Odor Threshold: Data not available.		

6. FIRE HAZARDS 6.1 Flash Point: >226°F 6.2 Flammable Limits in Air: Data not available. 6.3 Fire Extinguishing Agents: Water, foam, dry chemical, or carbon dioxide. 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent. 6.5 Special Hazards of Combustion Products: Irritating gases are generated in fires. 6.6 Behavior in Fire: Not pertinent. 6.7 Ignition Temperature: Data not available. 6.8 Electrical Hazard: Not pertinent. 6.9 Burning Rate: Data not available.		8. WATER POLLUTION 8.1 Aquatic Toxicity: 0.276 ppm/96 hr/bluegill/T.L.m./fresh water; 0.001 ppm/36-1080 hr/pinfish/T.L.m. salt water. 8.2 Waterfowl Toxicity: L.D. ₅₀ 2000 ppm (mallard duck). 8.3 Biological Oxygen Demand (BOD): Very low. 8.4 Food Chain Concentration Potential: High.
7. CHEMICAL REACTIVITY 7.1 Reactivity with Water: No reaction. 7.2 Reactivity with Common Materials: No reaction. 7.3 Stability During Transport: Stable. 7.4 Neutralizing Agents for Acids and Bases: Not pertinent. 7.5 Polymerization: Not pertinent. 7.6 Inhibitor of Polymerization: Not pertinent.		9. SELECTED MANUFACTURERS Monsanto Industrial Chemical Co. 800 North Lindbergh Blvd. St. Louis, Mo 63106.
11. HAZARD ASSESSMENT CODE (See Hazard Assessment Manual, CB 445-3). II		10. SHIPPING INFORMATION 10.1 Grades or Purities: 11 grades (some liquid, some solids) which differ primarily in their chlorine content (20-48% by weight). 10.2 Storage Temperature: Ambient. 10.3 Inert Atmosphere: No requirement. 10.4 Venting: Open.
12. HAZARD CLASSIFICATIONS 12.1 Code of Federal Regulations: Not listed. 12.2 IAS Hazard Rating for Bulk Water Transportation: Not listed. 12.3 IUPAC Hazard Classifications: Not listed.		13. PHYSICAL AND CHEMICAL PROPERTIES 13.1 Physical State at 15°C and 1 atm: Solid or liquid. 13.2 Molecular Weight: Not pertinent. 13.3 Boiling Point at 1 atm: Very high. 13.4 Freezing Point: Not pertinent. 13.5 Critical Temperature: Not pertinent. 13.6 Critical Pressure: Not pertinent. 13.7 Specific Gravity: 1.3-1.5 at 20°C (liquid). 13.8 Liquid Surface Tension: Not pertinent. 13.9 Liquid-Water Interfacial Tension: Not pertinent. 13.10 Vapor (Gas) Specific Gravity: Not pertinent. 13.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent. 13.12 Latent Heat of Vaporization: Not pertinent. 13.13 Heat of Combustion: Not pertinent. 13.14 Heat of Decomposition: Not pertinent. 13.15 Heat of Solution: Not pertinent. 13.16 Heat of Polymerization: Not pertinent.
NOTES		

(Continued on pages 3 and 4)

PHG

PHOSGENE

<p>Common Synonyms: Carbonyl chloride</p>	<p>Liquefied compressed gas Colorless gas, or light yellow liquid Sweet or sharp odor Liquid sinks in water. Poisonous vapor is produced. Boiling point is 47°F</p>
<p>AVOID CONTACT WITH LIQUID AND VAPOR. Keep proper away. Wear goggles and self-contained breathing apparatus. Stop discharge if possible. Evacuate area in case of large discharge. Stay upwind and over water spray to "knock down" vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>	
<p>Fire</p>	<p>Not flammable POISONOUS GASES ARE PRODUCED WHEN HEATED. Wear goggles and self-contained breathing apparatus. Cool exposed containers and protect men effecting shut-off with water.</p>
<p> Exposure</p>	<p>CALL FOR MEDICAL AID VAPOR POISONOUS IF INHALED. Irritating to eyes, nose, and throat. Effects may be delayed. Move to fresh air. If breathing has stopped, give artificial respiration (but NOT mouth-to-mouth). If breathing is difficult, give oxygen. Maintain absolute rest until medical aid arrives.</p>
<p>Water Pollution</p>	<p>Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.</p>
<p>1. RESPONSE TO DISCHARGE See Response Methods Handbook, CG 446-31 Issue warning: poison Restrict access Evacuate area</p>	<p>2. LABEL</p> 
<p>3. CHEMICAL DESIGNATIONS</p> <p>3.1 Synonyms: Carbon tetrachloride Chloroformyl chloride</p> <p>3.2 Coast Guard Compatibility Classification: Not applicable</p> <p>3.3 Chemical Formula: COCl₂</p> <p>3.4 IMCO/United Nations Numerical Designation: 2.0.1076</p>	<p>4. OBSERVABLE CHARACTERISTICS</p> <p>4.1 Physical State (as shipped): Compressed gas</p> <p>4.2 Color: Colorless</p> <p>4.3 Odor: Sharp, pungent odor in higher concentrations; like new-mown grass in low concentrations</p>
<p>5. HEALTH HAZARDS</p> <p>5.1 Personal Protective Equipment: Approved U.S. Bureau of Mines respirator; protective clothing</p> <p>5.2 Symptoms Following Exposure: Irritates lungs, causing delayed pulmonary edema. Slight gasping produces dryness or burning sensation in the throat, numbness, pain in the chest, bronchitis, and shortness of breath.</p> <p>5.3 Treatment for Exposure: INHALATION: remove victim from contaminated area, enforce absolute rest, call a doctor.</p> <p>5.4 Toxicity by Inhalation (Threshold Limit Value): 0.1 ppm</p> <p>5.5 Short-Term Inhalation Limits: 1 ppm for 5 min</p> <p>5.6 Toxicity by Ingestion: Not pertinent</p> <p>5.7 Late Toxicity: Severe delayed pulmonary edema</p> <p>5.8 Vapor (Gas) Irritant Characteristics: Vapors cause severe irritation of eyes and throat and can cause eye and lung injury. They cannot be tolerated even at low concentrations.</p> <p>5.9 Liquid or Solid Irritant Characteristics: Severe irritant to all tissues</p> <p>5.10 Odor Threshold: 0.5 ppm</p>	

<p>6. FIRE HAZARDS</p> <p>6.1 Flash Point: Not flammable</p> <p>6.2 Flammable Limits in Air: Not flammable</p> <p>6.3 Fire Extinguishing Agents: Water to cool containers</p> <p>6.4 Fire Extinguishing Agents Not to be Used: Not pertinent</p> <p>6.5 Special Hazards of Combustion Products: Toxic gas is generated when heated.</p> <p>6.6 Behavior in Fire: Not pertinent</p> <p>6.7 Ignition Temperature: Not flammable</p> <p>6.8 Electrical Hazard: Not pertinent</p> <p>6.9 Burning Rate: Not flammable</p>	<p>8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: Data not available</p> <p>8.2 Waterway Toxicity: Data not available</p> <p>8.3 Biological Oxygen Demand (BOD): None</p> <p>8.4 Food Chain Concentration Potential: None</p>								
<p>7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity with Water: Decomposes, but not vigorously</p> <p>7.2 Reactivity with Common Materials: No reaction</p> <p>7.3 Stability During Transport: Stable</p> <p>7.4 Neutralizing Agents for Acids and Caustics: Can be absorbed in caustic soda solution. One ton of phosgene requires 2,400 lbs. of caustic soda dissolved in 100 gal. of water.</p> <p>7.5 Polymerization: Not pertinent</p> <p>7.6 Inhibitor of Polymerization: Not pertinent</p>	<p>9. SELECTED MANUFACTURERS</p> <p>1. BASF Corp. Mobay Chemical Co. Division Penn. Lincoln Plw., West Pittsburg, Pa. 15205</p> <p>2. E. I. du Pont de Nemours & Co., Inc. Elastomer Chemicals Dept. Wilmington, Del. 19898</p> <p>3. The Upjohn Co. Polymer Chemicals Division La Porte, Tex. 77571</p>								
<p>10. SHIPPING INFORMATION</p> <p>10.1 Grades or Purities: Commercial 100%</p> <p>10.2 Storage Temperature: Ambient</p> <p>10.3 Inert Atmosphere: No requirement</p> <p>10.4 Venting: Safety relief</p>									
<p>11. HAZARD ASSESSMENT CODE See Hazard Assessment Handbook, CG 446-31 A-C-1-1-0</p>	<p>12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 18°C and 1 atm: Gas</p> <p>12.2 Molecular Weight: 98.92</p> <p>12.3 Boiling Point at 1 atm: 46.9°F = 8.2°C = 281.4°K</p> <p>12.4 Freezing Point: -145°F = -102°C = 147°K</p> <p>12.5 Critical Temperature: 160°F = 71.2°C = 455°K</p> <p>12.6 Critical Pressure: 923 psia = 79.0 atm = 5.67 MN/m²</p> <p>12.7 Specific Gravity: 1.38 at 20°C (liquid)</p> <p>12.8 Liquid Surface Tension: 22.8 dynes/cm = 0.0228 N/m at 20°C</p> <p>12.9 Liquid-Water Interfacial Tension: Not pertinent</p> <p>12.10 Vapor (Gas) Specific Gravity: 3.4</p> <p>12.11 Ratio of Specific Heats of Vapor (Gas): 1.10</p> <p>12.12 Latent Heat of Vaporization: 110 Btu/lb = 25 cal/g = 2.5 x 10³ J/kg</p> <p>12.13 Heat of Combustion: Not pertinent</p> <p>12.14 Heat of Decomposition: Not pertinent</p> <p>12.15 Heat of Solution: Not pertinent</p> <p>12.16 Heat of Polymerization: Not pertinent</p>								
<p>12. HAZARD CLASSIFICATIONS</p> <p>12.1 Code of Federal Regulations: Poisonous gas or liquid, Class A</p> <p>12.2 HAS Hazard Rating for Bulk Water Transportation: Not listed</p> <p>12.3 HPPA Hazard Classifications:</p> <table data-bbox="958 1365 1201 1449"> <thead> <tr> <th>Category</th> <th>Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td> <td>4</td> </tr> <tr> <td>Flammability (Red)</td> <td>0</td> </tr> <tr> <td>Reactivity (Yellow)</td> <td>0</td> </tr> </tbody> </table>	Category	Classification	Health Hazard (Blue)	4	Flammability (Red)	0	Reactivity (Yellow)	0	<p>NOTES</p>
Category	Classification								
Health Hazard (Blue)	4								
Flammability (Red)	0								
Reactivity (Yellow)	0								

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Chemical Synonyms			
Industrial	Liquid	Silver	Oxides
AVOID CONTACT WITH LIQUID. Keep people away. Stop discharge if possible. Isolate and remove discharged material. Notify local health and pollution control agencies.			
Fire	Not flammable		
Exposure	68661606 MEDICAL AID Effects in exposure may be delayed		
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be adsorbed on suspended matter in water. Needs local health and pollution officials. Needs inspection of nearby water bodies.		
1. RESPONSE TO DISCHARGE See Response to Discharge, CO 40-40. Should be removed. Chemical and physical treatment.		2. LABELS No hazard label required by Code of Federal Regulation.	
3. CHEMICAL DESIGNATIONS 3.1 Synonyms: Quicksilver 3.2 Exact Quoted Compatibility Classification: Not applicable 3.3 Chemical Formula: Hg 3.4 IMCO/United Nations International Designation: Not listed		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Silver 4.3 Odor: None	


- 5. HEALTH HAZARDS**
- 5.1 Personal Protective Equipment: Avoid contact of liquid with skin. For vapor use chemical cartridge/flooded respirator.
- 5.2 Symptoms Following Exposure: No immediate warning. As poisoning becomes established, with muscular tremor, loss of appetite, nausea, and diarrhea are observed. Positive x-rays, and cardiovascular disturbances may occur.
- 5.3 Treatment for Exposure: Consult a doctor.
- 5.4 Toxicity by Ingestion (Threshold Limit Value): 0.05 mg/m³.
- 5.5 Short-Term Inhalation Limit: Data not available.
- 5.6 Toxicity by Ingestion: No immediate toxicity.
- 5.7 Lethal Toxicity: Development of mercury poisoning.
- 5.8 Vapor (Gas) Irritant Characteristics: None.
- 5.9 Liquid or Solid Irritant Characteristics: None.
- 5.10 Other Threshold: Not pertinent.

5. FIRE HAZARDS			
6.1 Flash Point: Not flammable	6.2 Flammable Limits in Air: Not flammable	6.3 Fire Extinguishing Agents: Not pertinent	6.4 Fire Extinguishing Agents that to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Not pertinent	6.6 Behavior in Fire: Not pertinent	6.7 Ignition Temperature: Not flammable	6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not flammable			
7. CHEMICAL REACTIVITY			
7.1 Reactivity with Water: No reaction	7.2 Reactivity with Common Materials: No reaction	7.3 Stability During Transport: Stable	7.4 Neutralizing Agents for Acids and Gases: Not pertinent
7.5 Polymerization: Not pertinent	7.6 Inhibition of Polymerization: Not pertinent		
8. WATER POLLUTION			
8.1 Aquatic Toxicity: 0.5 ppm (48 hr. exposure) TLm/1000 water	8.2 Withdrawal Toxicity: Data not available	8.3 Biological Oxygen Demand (BOD): None	8.4 Feed Chain Contamination Potentials: Mercury concentrations in liver and kidneys of ducks and geese 10 levels above FDA limit of 0.5 ppm. Mussels (steel usually well below the limit).
9. SELECTED MANUFACTURERS			
1. Barmont Smelting and Refining Works, Inc. 130 Belmont Ave. Brooklyn, N. Y. 11207	2. Engelhard Minerals and Chemical Corp. Phillips Bros. Division 299 Park Ave. New York, N. Y. 10017	3. NL Industries Toledo Iron Division 893 W. 14th St. Chicago, Ill. 60606	
10. SHIPPING INFORMATION			
10.1 Grades or Purity: Pure	10.2 Storage Temperature: Ambient	10.3 Inner Atmosphere: No requirement	10.4 Venting: Open
11. HAZARD ASSESSMENT CODE			
See hazard assessment Tables, CO 40-40. A, N			
12. HAZARD CLASSIFICATIONS			
12.1 Code of Federal Regulations: UN 18	12.2 HAZ Hazard Rating for Bulk Water Transportation: Not listed	12.3 IMPA Hazard Classification: Not listed	
13. PHYSICAL AND CHEMICAL PROPERTIES			
13.1 Physical State at 15°C and 1 atm: Liquid	13.2 Molecular Weight: 200.59	13.3 Boiling Point at 1 atm: 357°C (673°F)	13.4 Freezing Point: -38.9°C (-34°F) = -39°C
13.5 Critical Temperature: 270°C = 518°F	13.6 Critical Pressure: 23,300 psi = 1587 atm = 160.8 MN/m ²	13.7 Specific Gravity: 13.5 at 20°C (68°F)	13.8 Liquid Surface Tension: 470 dyne/cm = 740 N/m at 20°C
13.9 Liquid-Vapor Interfacial Tension: 175 dyne/cm = 0.175 N/m at 20°C	13.10 Vapor (Gas) Specific Gravity: Not pertinent	13.11 Heat of Specific Heats of Vapor (Gauss): Not pertinent	13.12 Latent Heat of Vaporization: Not pertinent
13.13 Heat of Combustion: Not pertinent	13.14 Heat of Combustion: Not pertinent	13.15 Heat of Solution: Not pertinent	13.16 Heat of Polymerization: Not pertinent

NOTES

VCM

VINYL CHLORIDE

Common Synonyms Chloroethene VCL Vinyl C Monomer		Liquidified compressed gas Colorless Sweet odor
Liquid floats and boils on water. Flammable, irritating visible vapor cloud is produced.		
Stop discharge if possible. Keep people away. Shut off upstream valves and call fire department. Stay upwind and use water spray to "knock down" vapor. Evacuate area in case of large discharge. Avoid contact with liquid and vapor. Notify local health and pollution control agencies.		
Fire	FLAMMABLE POISONOUS GAS IS PRODUCED IN FIRE Flashback along vapor trail may occur. May explode if ignited in an enclosed area. Wear self-contained breathing apparatus. Cool exposed containers and protect area reflecting sheet/ with water. Stop flow of gas if possible. Let fire burn. Extinguish small fires with dry chemical.	
Exposure	CALL FOR MEDICAL AID VAPOR Irritating to eyes, nose, and throat. If inhaled, will cause dizziness or difficult breathing. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Will cause frostbite. Flush affected areas with plenty of water. DO NOT RUB AFFECTED AREAS	
Water Pollution	Not harmful to aquatic life	
1. RESPONSE TO DISCHARGE (See Response Methods Handbook, CG 440-4) Issue warning: high flammability. Evacuate area.		2. LABEL  Red
3. CHEMICAL DESIGNATIONS 3.1 Synonyms: Chloroethene Chloroethene Vinyl C Monomer VCL VCM 3.2 Coast Guard Compatibility Classification: Vinyl halides 3.3 Chemical Formula: CH ₂ =CHCl 3.4 IMCO/United Nations Numerical Designation: 2.0.108a		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquidified gas 4.2 Color: Colorless 4.3 Odor: Pleasant, sweet
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Rubber gloves and shoes, gas-tight goggles, organic vapor canister or self-contained breathing apparatus. 5.2 Symptoms Following Exposure: INHALATION: high concentrations cause dizziness, anesthesia, lung irritation. SKIN: may cause frostbite, phenol inhibitor may be absorbed through skin if large amounts of liquid evaporate. 5.3 Treatment for Exposure: INHALATION: remove patient to fresh air and keep him quiet and warm; call a doctor; give artificial respiration if breathing stops. EYES AND SKIN: flush with plenty of water for at least 15 min.; for eyes, get medical attention; remove contaminated clothing. 5.4 Toxicity by Inhalation (Threshold Limit Value): 200 ppm 5.5 Short-Term Inhalation Limit: 500 ppm for 5 min. 5.6 Toxicity by Ingestion: Not pertinent. 5.7 Late Toxicity: Chronic exposure may cause liver damage. 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin. May cause frostbite. 5.10 Odor Threshold: 260 ppm		

6. FIRE HAZARDS

- 6.1 Flash Point: $-110^{\circ}\text{F} (-73^{\circ}\text{C})$
- 6.2 Flammable Limits in Air: 4.1-26%
- 6.3 Fire Extinguishing Agents: For small fires use dry chemical or carbon dioxide. For large fires stop flow of gas. Cool exposed containers with water.
- 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
- 6.5 Special Hazards of Combustion Products: Forms highly toxic combustion products such as hydrogen chloride, phosgene, and carbon monoxide.
- 6.6 Behavior in Fire: Container may explode in fire. Gas is heavier than air and may travel considerable distance to a source of ignition and flash back.
- 6.7 Ignition Temperature: 882°F
- 6.8 Electrical Hazard: Class I, Group D
- 6.9 Burning Rate: 4.3 mm/min

7. CHEMICAL REACTIVITY

- 7.1 Reactivity with Water: No reaction
- 7.2 Reactivity with Common Materials: No reaction
- 7.3 Stability During Transport: Stable
- 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
- 7.5 Polymerization: Polymerizes in presence of air, sunlight, or heat unless stabilized by inhibitors.
- 7.6 Inhibitor of Polymerization: Not normally used except when high temperatures are expected. Then 40-100 ppm of phenol used.

8. WATER POLLUTION

- 8.1 Aquatic Toxicity: None
- 8.2 Waterfowl Toxicity: None
- 8.3 Biological Oxygen Demand (BOD): None
- 8.4 Food Chain Concentration Potential: None

9. SELECTED MANUFACTURERS

1. Dow Chemical Co.
Midland, Mich. 48660
2. The B. F. Goodrich Co.
4100 Oak Tree Blvd.
Cleveland, Ohio 44131
3. PPG Industries, Inc.
Chemical Division
Cranston, Puerto Rico 00656

10. SHIPPING INFORMATION

- 10.1 Grades or Purities: Commercial or technical 99+ %
- 10.2 Storage Temperature: Under pressure ambient
At atm. pressure low
- 10.3 Inert Atmosphere: No requirement
- 10.4 Venting: Under pressure safety relief
At atm. pressure pressure-relief

11. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook, CG 440-3)
A-B-C-D-E-F-G-Z

13. PHYSICAL AND CHEMICAL PROPERTIES

- 13.1 Physical State at 15°C and 1 atm: Gas
- 13.2 Molecular Weight: 62.50
- 13.3 Boiling Point at 1 atm:
 $-13.2^{\circ}\text{F} = -23.5^{\circ}\text{C} = -10.3^{\circ}\text{F}$
 $-11.7^{\circ}\text{C} = -10.9^{\circ}\text{F}$
- 13.4 Freezing Point:
 $-24.8^{\circ}\text{F} = -30.6^{\circ}\text{C} = -10.9^{\circ}\text{F}$
- 13.5 Critical Temperature:
 $117.1^{\circ}\text{F} = 158.4^{\circ}\text{C} = 431.6^{\circ}\text{K}$
- 13.6 Critical Pressure:
 $55.8 \text{ atm} = 5.58 \text{ MPa}$
- 13.7 Specific Gravity: 0.962 at -13°C (liquids)
- 13.8 Liquid Surface Tension:
 $16.0 \text{ dynes/cm} = 0.0162 \text{ N/m}$ at 25°C
- 13.9 Liquid-Water Interfacial Tension: (est.)
 $30.4 \text{ dynes/cm} = 0.0304 \text{ N/m}$ at 20°C
- 13.10 Vapor (Gas) Specific Gravity: 2.2
- 13.11 Rate of Specific Heat of Vapor (Gas): 1.136
- 13.12 Latent Heat of Vaporization:
 $100 \text{ Btu/lb} = 88 \text{ cal/g} = 3.7 \times 10^3 \text{ J/kg}$
- 13.13 Heat of Combustion: -81.6 Btu/lb
 $= -4520 \text{ cal/g} = -18.9 \times 10^3 \text{ J/kg}$
- 13.14 Heat of Decomposition: Not pertinent
- 13.15 Heat of Solution: Not pertinent
- 13.16 Heat of Polymerization: -129 Btu/lb
 $= -405 \text{ cal/g} = -16.9 \times 10^3 \text{ J/kg}$

12. HAZARD CLASSIFICATIONS

- 12.1 Code of Federal Regulations:
Flammable compressed gas
- 12.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	4
Health	
Vapor Irritant	2
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	0
Aquatic Toxicity	0
Acute Effect	0
Reactivity	
Other Chemicals	2
Water	0
Self-Reaction	2
- 12.3 NFPA Hazard Classifications:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	4
Reactivity (Yellow)	1

NOTES

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ecology and environment, inc.

ON-SITE SAFETY LOG

	Background Reading in Breathing Zone	Calibrated At	On-Site Reading in Breathing Zone
A. On-Site Monitoring			
1. HNU/OVA and calibration gas			
2. Rad-mini			
3. Monitox			
4. O ₂ /Explosimeter and calibration gas			
5. Dust monitor			

B. Protective Clothing Worn: _____

C. Site Name: Dead Creek Project Project Number: _____
Date: _____
Weather Conditions: _____
Name of Attendees at Site: _____

D. Comments on Monitoring or Protective Clothing: _____

Name	Signature
Team Leader: <u>M. McCarrin</u>	_____
Site Safety Officer: <u>D. Sewall</u>	_____

HISTORY

The study area for the Dead Creek Project (DCP) consists of 18 sites in the towns of Sauget and Cahokia in St. Clair County, Illinois (see attached map). The Illinois EPA became aware of the problems in this area in 1980 when periodic smoldering of materials in a ditch (Dead Creek) was observed. Following an initial inspection, the agency received information that a local resident's dog had come in contact with wastes in the ditch and died of apparent chemical burns.

Historically, during World War II, the study area was heavily developed by industry to support the war effort. Due to this development and the geologic conditions in the area, open pit mining occurred in many areas to supply sand and gravel resources. Following the war, excess product was landfilled and covered in the numerous excavations. Wastes reported to have been buried in these excavations include phosphine gas and munitions in addition to organic and inorganic industrial wastes. The excavated areas were identified by the Illinois EPA from a series of past aerial photographs, and by a thermal infrared survey of the area.

The filling of past excavations was followed by utilization of Dead Creek as receiving water for effluent and surface drainage of various industries. The Illinois EPA performed a preliminary study of the area in 1980, finding excessive levels of organic and inorganic contaminants in and around the creek. Contaminants detected included: PCBs, aliphatic hydrocarbons, dichlorobenzene, lead, cadmium, and arsenic. During the Illinois EPA study, drillers were overcome by organic vapors while installing a monitoring well east of the creek

and adjacent to a former seepage lagoon. Sampling of this well and the lagoon indicated high levels of the aforementioned contaminants.

Following World War II, chemical companies in the area returned to normal processes, including the manufacturing of defoliants, pesticides, and herbicides. From the mid-1950s to the early 1970s, the byproducts and wastes from these manufacturing processes were land-filled in the Site R and possibly Site Q areas (see map). Drilling and sampling by E & E in 1983 at Site Q indicated the presence of 63 of the 117 priority pollutants designated by the USEPA, including quantifiable levels of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Dioxin was also detected in soil samples at Site O. Site P is an Illinois EPA-permitted landfill known to have accepted hazardous waste residues in violation of their permit.

DEAD CREEK

Site G (Inactive Site). Drums and pits observed on the surface. Appear to contain oily wastes (drums - unknown black cinder-like solid).

Contaminants detected in groundwater: PCB (1.0 ppb), chlorophenol (1,200 ppb), chlorobenzene (19 ppb), dichlorobenzene (25 ppb), dichlorophenol (890 ppb), phosphorus (9.4 ppm), and lead (.31 ppm); surface soils: arsenic (16 ppm), lead (2,000 ppm), and PCB (350 ppm).

Death profile from creek shows PCB ranging from 9,200 ppm at the surface to 54 ppm at 6 feet.

November 1985 - no readings above background with site entry equipment. Physical hazards - three or four pits with exposed drums, numerous areas mounded with buried drums, poison ivy.

Site H (Inactive Site). Former sand and gravel pit which was filled with construction debris and unknown wastes. Presently covered and well vegetated. Physical hazards - trip and fall. One downgradient well - PCB - 1.0 ppb. No surface soil sampling done. No pits, ponds, etc. on-site.

Site T (Active Plant Site). Cerro copper property. Holding lagoon on site was formerly head water per Dead Creek. Culvert under New Queeny Avenue was blocked sometime after 1950. G112 only groundwater monitoring point for the site - analysis indicates chlorobenzene and dichlorobenzene, along with metals. Soil samples from areas

adjacent to the holding pond indicate PCB (0.3 ppm) and aliphatic hydrocarbons (26 ppm) along with dichlorobenzene (1.7 ppm). Also arsenic (95.8 ppm). Surface water samples from holding pond show: nickel (4.2 ppm), arsenic (0.58 ppm), zinc (30 ppm), PCB (28 ppm), aliphatic hydrocarbons (23,000 ppm).

Plant site: Level D with hardhat, safety glasses, necessary - presently no water in former holding pond. Sand and gravel pit identified from historical aerial photos now filled and covered (parking area for trailers).

Site J (Active Plant Site). Sterling Steel Castings. No previous study done. Aerial photos indicate possible disposal. From visual observation and conversation with plant operator, material disposed of consists of casting sand and slag. (Needs groundwater monitoring). Two pits exist on site approximately 30' deep. Two to three drums are evident along the sides. Site also has an inactive incinerator. Possible contaminants include epoxy resins, heavy metals.

Site K (Residential Commercial). No information exists for this site. Historical aerial photos indicate possible dumping. Presently, trailer homes and a small trucking company occupy the property.

Site L (Active Equipment Repair Site). Historical photos indicate a small surface impoundment once existed on the site (Wagganer Trucking). Wagganer was an industrial waste hauler - trucks cleaned on site discharge first into creek, then into impoundment. Wagganer specialized in hauling hazardous materials. Downgradient groundwater analysis: chlorophenol (19 ppb), and cyclohexane (120 ppb). Soils: PCB (5,200 ppm), trichlorobenzene (78 ppm), and hydrocarbons: (21,000 ppm). Presently, site is covered with cinders with no evidence of where the pit was situated.

Site M (Inactive Pit). Hall Const. Pit - site consists of an open pit used for dumping of unknown wastes. Surface soils: PCB, arsenic, and mercury. Surface water: PCB, phosphorus (low levels). Presently, pit is inside fence which surrounds Dead Creek between New Queeeny Avenue and Judith Lane. Steep sloping sides, water present in pit.

Site N (Inactive Construction Site). No historical information is available for this site. Historical photos indicate possible disposal. Presently site is occupied by an inactive construction company. No previous studies performed.

Site O (Active STP). American Bottany wastewater treatment plant. Historically, three lagoons were used for sludge dewatering. Lagoon area is now covered and vegetated. Preliminary sampling indicates PCB, miscellaneous hydrocarbons. No field work proposed for initial phase of study.

Site P (Inactive Permitted Landfill). An IEPA permitted landfill known to have accepted hazardous residues in violation of their permit. Types and quantities of wastes recorded are unknown. No sampling has been done at the site. Presently municipal and construction debris (asbestos) are evident along with cinders, no drums evident. Site is still permitted, though no longer active.

Site Q (Inactive Landfill - Active Transport Facility). Consists of a former unpermitted landfill suspected of receiving hazardous wastes. Located adjacent to the Sauget Toxic Dump. E & E sampling (soil borings) indicated the presence of 63 priority pollutants, including 2378-TCAA. No groundwater monitoring has been done at the site - power lines traverse the entire area. Area covered entirely by black cinders. Some refuse (appliances, debris, etc.) randomly dumped in rear portion of property.

Site R (Inactive Landfill). Sauget Toxic Dump - Former chemical dump owned and operated by Monsanto. Contaminants detected in leachate include solvents and 2,3,7,8-TCAA (Tot sampling - 1981). Presently, site is well covered and vegetated. Monsanto tank farm for feedstocks located in the northern portion of the site. No drilling expected. Hard hat and safety glasses required by Monsanto.

5.8 SAMPLE CONTAINERS

The volumes and containers required for the sampling activities are included in Tables 5-1 and 5-2. Pre-washed sample containers will be provided by E & E's ASC and prepared in accordance with USEPA bottle washing procedures. These procedures are incorporated in E & E's Laboratory and Field Personnel Chain-of-Custody Documentation and Quality Assurance/Quality Control Procedures Manual, April 1986.

Table 5-1

SAMPLE CONTAINERS, VOLUMES, PRESERVATION,
AND HOLDING TIMES FOR WATER SAMPLES

Type of Analysis	Type and Size of Container	Number of Containers and Sample Volume (per Sample)	Preservation	Maximum Holding Time
Purgeable (Volatile) Organics	40-ml glass vial with teflon-backed septum	Two (2); fill completely, no air space	Cool to 4°C (ice in cooler)	7 days
Extractable Organics, PCBs, Pesticides	1/2-gallon bottles with teflon-lined caps	Two (2); total volume approx. 1 gallon; fill completely	Cool to 4°C (ice in cooler)	Must be extracted within 5 days; analyzed within 30 days
Metals	1-liter polyethylene bottle with polyethylene-lined caps	One (1); fill 7/8 full	Nitric acid to below pH 2 (approx. 1.5 ml Con HNO ₃ per liter)	6 months
Cyanides	1-liter polyethylene bottle with polyethylene-lined caps	One (1); fill completely	Sodium hydroxide to pH 12 and cool to 4°C (ice in cooler)	24 hours, if sulfide present; 14 days

Note: All sample bottles will be prepared in accordance with USEPA bottle washing procedures. These procedures are incorporated in E & E's Laboratory and Field Personnel Chain-of-Custody Documentation and Quality Assurance/Quality Control Procedures Manual, April 1986.

Table 5-2

SAMPLE CONTAINERS, VOLUMES, PRESERVATION,
AND HOLDING TIMES FOR SOIL SAMPLES

Type of Analysis	Type and Size of Container	Number of Containers and Sample Volume (per Sample)	Preservation	Maximum Holding Time
Purgeable (Volatile) Organics	40-ml glass vial with Teflon-backed septum	Two (2); fill completely, no air space	Cool to 4°C (ice in cooler)	10 days
Extractable Organics, PCBs, Pesticides	8-oz. glass jar with Teflon-lined cap	One (1); fill completely	Cool to 4°C (ice in cooler)	Must be extracted within 10 days; analyzed within 30 days
Metals	8-oz. glass jar with Teflon-lined cap	One (1); fill half-full	Cool to 4°C (ice in cooler)	6 months
Cyanides	8-oz. glass jar with Teflon-lined cap	One (1); fill completely	Cool to 4°C (ice in cooler)	24 hours, if sulfide present;
2,3,7,8 TCDD	8-oz. glass jar with Teflon-lined cap	One (1); fill completely	Cool to 4°C (ice in cooler)	Must be extracted within 5 days; analyzed within 30 days

Note: All sample bottles will be prepared in accordance with USEPA bottle washing procedures. These procedures are incorporated in E & E's Laboratory and Field Personnel Chain-of-Custody Documentation and Quality Assurance/Quality Control Procedures Manual, April 1986.

6. SAMPLE CUSTODY

6.1 STANDARD OPERATING PROCEDURES

This section describes standard operating procedures for sample identification and chain-of-custody. The purpose of these procedures is to ensure that the quality of the samples is maintained during their collection, transportation, and storage through analysis. All chain-of-custody requirements comply with standard operating procedures indicated in USEPA sample handling protocol. All sample control and chain-of-custody procedures applicable to the E & E ASC are presented in E & E's Laboratory and Field Personnel Chain-of-Custody Documentation and Quality Assurance/Quality Control Procedures Manual, April 1986.

Sample identification documents must be carefully prepared so that sample identification and chain-of-custody can be maintained and sample disposition controlled. Sample identification documents include:

- Field notebooks;
- Sample label;
- Custody seals; and
- Chain-of-custody records.

6.1.1 Chain-of-Custody

The primary objective of the chain-of-custody procedures is to provide an accurate written record that can be used to trace the

- Photographer (signature),
- Weather conditions,
- Description of photograph taken,
- Reasons why photograph was taken,
- Sequential number of the photograph and the film roll number,
and
- Camera lens system used.

After the photographs have been developed, the information recorded in the field notebook should be transferred to the back of the photographs.

6.1.3 Sample Handling, Packaging, and Shipping

The transportation and handling of samples must be accomplished in a manner that not only protects the integrity of the sample but also prevents any detrimental effects due to the possible hazardous nature of samples. Regulations for packaging, marking, labeling, and shipping hazardous materials are promulgated by the United States Department of Transportation (DOT) in the Code of Federal Regulations, 49 CFR 171 through 177.

All chain-of-custody requirements must comply with standard operating procedures in the USEPA sample handling protocol. All sample control and chain-of-custody procedures applicable to the E & E Analytical Services Center (ASC) are presented in E & E's Laboratory and Field Personnel Chain-of-Custody Documentation and Quality Assurance/Quality Control Procedures Manual, April 1986.

Sample Packaging

Samples must be packaged carefully to avoid breakage or contamination and must be shipped to the laboratory at proper temperatures. The following sample packaging requirements will be followed:

Chain-of-Custody Documentation and Quality Assurance/Quality Control
Procedures Manual, April 1986.

50440

Need

JOAC -

Journal of Association of Analytical Chemists

1983. Vol. 66 p. 1345

1986 Vol 69 p 214

Vol 69 p 586

Sample numbers. 79 109 215

216

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Vol. 1. 1980-81.

Program- Selective Surveillance.

D.V

7 9 -109-215

1. CF NO.	15. JD-TAIB. COUNTY	17. DATE COLLE	COMM. CODE	18. RESPI FIRM	19. DATA CONTROLLING	20. PROJ	21. COL
39	163	8/16/79	16AIA09		05007A		10
12. RELATED SPL	113. PC	114. COLL NO	115. SPLNG DIST	116. COLL'DIST			
INV79-109-216	2	204	Chi	Chi			
17. PRODUCT NAME AND IDENTIFICATION (Quote pertinent labeling including firm name and address)							
Fresh carp fish from area of Mississippi River bordering & just South of Monsanto Co., hazardous waste disposal site in Sauget, IL. This site was in use for approx. 20 years & rests on a sandy soil near the bank of the Mississippi River. Ground water flows to and from the river depending upon stage of river. This site has one of the highest potentials for PCB & dioxin (2,3,7,8 TCDD isomer) contamination of the river of any site thus far known. It may be one of the largest hazardous waste disposal sites in the U.S. Over 50,000 cubic yards of hazardous waste materials went into this site in two years (1968 & 1972). PCB's at nearly 3X above 5 ppm were detected in fish collected over 10 miles South of this site. Other major industries influencing this area of the							
18. REASON FOR COLLECTION (Indicate analysis needed & document assignment. Include CP No. and/or Assignment No. if applicable.)						19. MFG CODES, Labels, pkg, shipping container	
05007A Pesticides & Metals in Fish Program: check for chemical & metal contaminants.						None	
20. MANUFACTURER (Name, address & ZIP)			21. SHIPPER (Name, address & ZIP)			22. DEALER (Name, address, ZIP & telephone)	
N/A			N/A			N/A- send copy of analytical results to Illinois Dept. of Conservation, Division of Fisheries, Springfield, IL.	
23. SIZE OF LOT FROM WHICH SAMPLED			24. EST VALUE		25. RECEIPT ISSUED	26. DATE SHIPPED & DOC REF	
Mississippi River Fish population			None		FD472 FD 484 NONE	N/A	
27. DESCRIPTION OF SAMPLE AND METHOD OF COLLECTION (Number and size of units, etc.)							
5 carp fish taken by electric shocking from area of Mississippi River bordering & South of Monsanto Co.'s hazardous waste disposal site in Sauget, IL.							
28. HOW PREPARED							
Heads & entrails removed & fish individually wrapped in aluminum foil. Wrapped fish placed in plastic bag, bag ident., & officially sealed. Sealed sample pl., in add enpg ctn with dry ice for shipment to Min-DO.							
29. COLL IDENT FOR PKG AND/OR LABEL				30. COLLECTOR'S IDENTIFICATION ON SEAL			
INV79-109-215 8/16/79 KOB				INV79-109-215 8/16/79 Kenneth C. Buercklin			
31. SAMPLE DELIVERED TO				32. DATE DELIVERED		33. LAF	
Greyhound Bus Lines				8/20/79		Min	
St. Louis, Mo.				34. LAB W/SPLIT SAMPLE		35. ORIG C/R & RECORDS TO	
						Min	
36. INVOICE NO. AND DATE				37. SHIPPING RECORD (B/L, F/B, Waybill, Affidavit, etc.) NO. AND DATE			
N/A				N/A			
38. OTHER DOCUMENTS (Affidavits from dealers, etc.) SIGNER'S NAME AND DATE							
Photocopies of Monsanto Co. letters dated August 16, 1968 & November 27, 1972 which indicate the quantities and types of wastes disposed of in their dump.							
39. REMARKS (If additional space is needed, attach Form FD 464a, C/R Continuation Sheet)							
Mississippi River are: *17- Cerro Copper Products; Amax Zinc Co.; Midwest Rubber Reclaiming Co., and Edwin Cooper Co. (a mfr. of petroleum additives)							
38. CONSUMER COMPLAINT NO.		39. AMT. \$		40. 704(d) SPL		41. COLLECTOR (Typed name and signature)	
		C N/C E		YES NO		Kenneth C. Buercklin	

FORM FD 464 (10/77)

COLLECTION REPORT

COLLECTING DISTRICT MONITOR 5

Survey of Fish and Wildlife Resources
Program- Selective Surveillance

BY

79-109-216

1. CP NO.	2. JD-TAIG. COUNTY	3. DATE COLLE	4. COMM. CODE	5. RESP. FIRM	6. DATA CONTROLLING	7. PROJ.	8. REL. NO.
	39	163	8/16/79	16AYAH1	05007A		10
12. RELATED SPL	13. PC	14. COLL NO	15. SPLNG DIST	16. COLL'S DIST			
INV79-109-215	2	204	Chi	Chi			
17. PRODUCT NAME AND IDENTIFICATION (Quote pertinent labeling including firm name and address)							
Fresh carp sucker fish from area of Mississippi River bordering and just Setu South of Monsanto Company Co.'s hazardous waste disposal site in Sauget, IL. See C/R covering background on sampling area (INV79-109-215).							
I-DOC, Division of Fisheries employees, Charlie Marbut, Richard Rompasky, and Mike Cochran provided equipment and assistance necessary to collect sample.							
18. REASON FOR COLLECTION (Indicate analysis needed & document assignment. Include CP No. and/or Assignment No. if applicable.)					19. MFG CODES (Labels, pkg, shipping containers)		
05007A Pesticides & Metals in Fish Program; check for chemical contaminants. See INV79-109-215 for background.					None		
20. MANUFACTURER (Name, address & ZIP)			21. SHIPPER (Name, address & ZIP)		22. DEALER (Name, address, ZIP & telephone)		
N/A			N/A		N/A - send copy of analytical results to Illinois Dept. of Conservation, Division of Fisheries, Springfield, IL.		
23. SIZE OF LOT FROM WHICH SAMPLED			24. EST VALUE		25. RECEIPT ISSUED		26. DATE SHIPPED & DOC REF
Mississippi River fish population			None		FD472 FD484 NONE		N/A
27. DESCRIPTION OF SAMPLE AND METHOD OF COLLECTION (Number and size of units, etc.)							
6 carp sucker fish taken by electric shocking from area described in block #17.							
28. HOW PREPARED							
Heads & entrails removed & each fish individually wrapped in aluminum foil. Wrapped fish placed in plastic bag, bag ident., and officially sealed. Sealed samples pl. in coold ctn with dry ice for shipment to Min-DO.							
29. COLL IDENT ON PKG AND/OR LABEL			30. COLLECTOR'S IDENTIFICATION ON SEAL				
INV79-109-216 8/16/79 KOB			INV79-109-216 8/16/79 Kenneth O. Buercklin				
31. SAMPLE DELIVERED TO			32. DATE DELIVERED		33. LAE		
Greyhound Bus Lines St. Louis, Mo.			8/20/79		Min		
			34. LAB W/ SPLIT SAMPLE		35. ORIG C/R & RECORDS TO		
					Min		
36. INVOICE NO. AND DATE			36. SHIPPING RECORD (B/L, F/B, Waybill, Affidavit, etc.) NO. AND DATE				
N/A			N/A				
36. OTHER DOCUMENTS (Affidavits from dealers, etc.) SIGNER'S NAME AND DATE							
see copies of Monsanto Co. letters submitted with INV79-109-215. Attached photocopy of 6/3-10/79 article in St. Louis Globe Democrat paper.							
37. REMARKS (If additional space is needed, attach Form FD-464, C/R Continuation Sheet)							
38. CONSUMER COMPLAINT NO.		39. AMT. \$		40. 704(d) SPL		41. COLLECTOR (Typed name and signature)	
		N/C				Kenneth O. Buercklin	
CRED. CD.		C V E		YES NO			
				XX			

FORM FD 464 (10/77)

COLLECTION REPORT

COLLECTING DISTRICT MONITOR 5

INT

E O -178-326

8/5/80 16AXA09		05007A	10. DATA CONTROL NO.		11. PROJ	12. HSE
INV80-178-327	2	20L	Chi	Chi		
17. PRODUCT NAME AND IDENTIFICATION (Quote pertinent labeling including firm name and address)						
Fresh Carp fish taken from area of Mississippi River bordering and immediately South of Monsanto Co.'s inactive hazardous waste disposal site located in Sanget, IL.						
Additional background on this sampling area was provided with INV79-109-215 and INV80-178-237.						
18. REASON FOR COLLECTION (Indicate analysis needed & document assignment. Include CP No. and/or Assignment No. if applicable.)				19. MFG CODES (Labels, pkg, shipping container)		
05007A Pesticides and Metals in Fish Program: check for chemical & heavy metal contaminants.				None		
20. MANUFACTURER (Name, address & ZIP)		21. SHIPPER (Name, address & ZIP)		22. DEALER (Name, address, ZIP & telephone)		
N/A		N/A		N/A		
23. SIZE OF LOT FROM WHICH SAMPLED		24. EST VALUE	25. RECEIPT ISSUED	26. DATE SHIPPED & DOCRE		
Mississippi River Fish population		?	FD472: FD484: NONE	N/A		
27. DESCRIPTION OF SAMPLE AND METHOD OF COLLECTION (Number and size of units, etc.)						
8 carp fish ranging in wt. from est. 1 lb., to 8 lbs., taken by electrical shocking of the above described area of the Mississippi River.						
28. HOW PREPARED Heads & entrails removed & fish individually wrapped in PCB free aluminum foil. Wrapped fish pl in plio-bags, plio-bags ident & officially sealed. Sealed sample frozen then packed in cold ctng with dry ice for shipment to Min-DO						
29. COLL IDENT ON PKG AND/OR LABEL		30. COLLECTOR'S IDENTIFICATION ON SEAL				
"INV80-178-326 8/5/80 KOB"		"INV80-178-326 8/5/80 Kenneth O. Buercklin"				
31. SAMPLE DELIVERED TO		32. DATE DELIVERED	33. LAB			
Greyhound Bus Lines		8/11/80	Min-DO			
ST. LOUIS, MO		34. LAB W/SPLIT SAMPLE	35. ORIG C/R & RECORDS TO			
K. St. Louis, IL			Min-DO			
36. RECIPIENT OBTAINED	a. INVOICE NO. AND DATE		b. SHIPPING RECORD (B/L, F/B, Waybill, Affidavit, etc.) NO. AND DATE			
	N/A		N/A			
	c. OTHER DOCUMENTS (Affidavits from dealers, etc.) SIGNER'S NAME AND DATE					
N/A						
37. REMARKS (If additional space is needed, attach Form FD 464a, C/R Continuation Sheet)						
Monsanto Co., would be the primary suspect for chemical contaminants found in these fish.						
38. CONSUMER COMPLAINT NO.	39. AMT. \$	40. 70410 SPL	41. COLLECTOR (Typed name and signature)			
	N/C		Kenneth O. Buercklin			
CRED. CC.	C	YES	NO			

FORM FD 464 (10/77)

COLLECTION REPORT

COLLECTING DISTRICT MONITOR 5

INT

80 -178-327

1. CP NO.		2. JUDGE COUNTY		3. DATE COLLECTED		4. COMM CODE		5. RESP FIRM		10. a. DATA CONTROL NO.		b. PROJ		11. HOUR	
				8/5/80		16AYAL1		*		05007A				5	
12. RELATED SPL				13. PC		14. COLL NO.		15. SPLICING DIST		16. COLL'S DIST					
INV80-178-326				2		204		Chd		Chd					
17. PRODUCT NAME AND IDENTIFICATION (Quote pertinent labeling including firm name and address)															
Fresh buffalo and carp sucker fish taken from area of Mississippi River bordering and immediately South of Monsanto Co.'s hazardous waste disposal site (inactive) located in Sanget, IL.															
Other industries which may influence the condition of these fish besides Monsanto Co., include the Sanget, Illinois Sewage Treatment plant, Cerro Copper Products, Amx Amx Zinc Co., Midwest Rubber Reclaiming Co., & Edwin Cooper CO.															
The inactive hazardous waste disposal site rests on sand on the bank of the River. It is the largest known site of its type in the area. The Monsanto plant which used the															
18. REASON FOR COLLECTION (Indicate analysis needed & document assignment. Include CP No. and/or Assignment No. if applicable.)												19. MFG CODES (Labels, pkg, shipping container)			
05007A Pesticides and Metals in Fish Program: check for chemical & heavy metal contaminants.												None			
20. MANUFACTURER (Name, address & ZIP)				21. SHIPPER (Name, address & ZIP)				22. DEALER (Name, address, ZIP & telephone)							
N/A				N/A				N/A							
23. SIZE OF LOT FROM WHICH SAMPLED						24. EST VALUE		25. RECEIPT ISSUED				26. DATE SHIPPED & DOCRE			
Mississippi River fish population						?		FD472 FD 484 NONE				X N/A			
27. DESCRIPTION OF SAMPLE AND METHOD OF COLLECTION (Number and size of units, etc.)															
2 buffalo and 4 carp suckers taken by electrical shocking from Mississippi River.															
28. HOW PREPARED Heads & entrails removed & fish individually wrapped in PCB free aluminum foil. Wrapped fish pl in plio-bag, plio-bag ident. & officially sealed. Sealed sample frozen, then packed in cold ctn with dry ice for shipment to MinnDO.															
29. COLL IDENT ON PKG AND/OR LABEL								30. COLLECTOR'S IDENTIFICATION ON SEAL							
INV80-178-327 8/5/80 KOB								INV80-178-327 8/5/80 Kenneth O. Buercklin							
31. SAMPLE DELIVERED TO						32. DATE DELIVERED				33. LAB					
Greyhound Bus Lines						8/11/80				Min					
St. Louis, Mo. I.C.						34. LAB W/SPLIT SAMPLE				35. ORIG C/R & RECORDS TO					
										Min					
36. RCDS OBTAINED	a. INVOICE NO. AND DATE						b. SHIPPING RECORD (B/L, F/B, Waybill, Affidavit, etc.) NO. AND DATE								
	N/A						N/A								
	c. OTHER DOCUMENTS (Affidavits from dealers, etc.) SIGNER'S NAME AND DATE														
N/A															
37. REMARKS (If additional space is needed, attach Form FD 464a, C/R Continuation Sheet)															
*17-site was the only mfr of PCB's in the U.S. and is known to have manufactured agent Orange. The 2,3,7,8 TCDD isomer has been detected in this plant's production and upon the plant's premises.															
*9- Monsanto Co., is the primary suspect for any chemical contaminants detected.															
38. CONSUMER COMPLAINT NO.				39. AMT. \$				40. 704(d) SPL				41. COLLECTOR (Typed name and signature)			
				N/C								Kenneth O. Buercklin			
CRED. CD.				C V B				YES NO							

FORM FD 464 (10/77)

COLLECTION REPORT

COLLECTING DISTRICT MONITOR :

1. PRODUCT <i>Case (Sub 2)</i>		2. SAMPLE NO. <i>INV 30-178-327</i>	
3a. SAMPLE CLASSIFICATION <small>(Insert classification code for each PAC No. represented by sample.)</small>		b. LABORATORY CONCLUSIONS	
CODE	PAC NO.	<i>This product contains 0.01ppm HCB, 0.03ppm p,p'-DDE, 0.26ppm PCB 1242, 0.50ppm PCB 1254, 0.12ppm PCB 1260, 0.04ppm heptachlor epoxide, 0.08ppm trans nonachlor, 0.12ppm trans chlordane, 0.11ppm cis chlordane, 0.02ppm cis nonachlor (0.33ppm total chlordane), 0.05ppm p,p'-DDD, 0.21ppm dieldrin, 0.07ppm heptachlorobutadiene and traces of diazinon, pentachlorobenzene and pentachloroanisole.</i>	
<i>5</i>			
c. NAME AND TITLE <i>Superior Chemist</i>		d. SIGNATURE <i>Robert P. Smith</i>	e. DATE <i>9-15-80</i>
4a. DISTRICT CONCLUSIONS			
b. NAME AND TITLE (District)		c. SIGNATURE	d. DATE

FORM FD 465 (4/78)

PREVIOUS EDITION IS OBSOLETE.

SAMPLE SUMMARY

1. PRODUCT <i>Buffalo Fish (Sub 1)</i>		2. SAMPLE NO. <i>INV 30-178-327</i>	
3a. SAMPLE CLASSIFICATION <small>(Insert classification code for each PAC No. represented by sample.)</small>		b. LABORATORY CONCLUSIONS	
CODE	PAC NO.	<i>This product contains 0.03ppm HCB, 0.07ppm p,p'-DDE, 0.45ppm PCB 1242, 0.77ppm PCB 1254, 0.14ppm PCB 1260, 0.03ppm heptachlor epoxide, ^{CPZ} trans chlordane 0.06ppm trans nonachlor, 0.11ppm trans chlordane, 0.11 cis chlordane, 0.03ppm cis nonachlor (0.33ppm total chlordane), 0.05ppm p,p'-DDD, 0.16ppm dieldrin, 0.09ppm HCB, and traces of diazinon, pentachlorobenzene and pentachloroanisole.</i>	
<i>5</i>			
c. NAME AND TITLE <i>Superior Chemist</i>		d. SIGNATURE <i>Robert P. Smith</i>	e. DATE <i>9-15-80</i>
4a. DISTRICT CONCLUSIONS <i>NFI SDN issued Ref to Chi-DD. See second FD 465 for comp.</i>			
b. NAME AND TITLE (District)		c. SIGNATURE <i>Robert P. Smith</i>	d. DATE <i>9-15-80</i>

FORM FD 465 (4/78)

PREVIOUS EDITION IS OBSOLETE.

SAMPLE SUMMARY

Identification of Chlorinated Nitrobenzene Residues in Mississippi River Fish

MARTIN P. YURAWECZ and BART J. PUMA

Food and Drug Administration, Division of Chemical Technology, Washington, DC 20204

Residues of lower chlorinated nitrobenzenes have been found at levels up to about 1 ppm in 8 samples of Mississippi River fish. Electron capture gas chromatography (EC/GC) was used for determination after extraction and cleanup using a procedure based on the AOAC multiresidue method for organochlorine and organophosphorus pesticides in nonfatty foods. The residues found included 2-, 3-, and 4-chloronitrobenzene and 2,3- and 3,4-dichloronitrobenzene; identity was confirmed by GC/mass spectrometry. GC retention times for 15 monochloro-through pentachloro-substituted nitrobenzene congeners were determined with OV-101 and mixed OV-101 + OV-210 columns at 130°C. In studies of the nonfatty food extraction and cleanup procedures of the AOAC method, recoveries of 15 chlorinated nitrobenzenes from spiked fish samples ranged from 68 to 116%. GC of cleaned up fish extract aliquots equivalent to 20 mg sample allowed quantitation of individual congeners at levels of about 0.025 and 0.005 ppm with ^3H and ^{63}Ni EC detectors, respectively. The contamination of Mississippi River fish with chlorinated nitrobenzenes appears to be localized in a 150 mile section of the river extending from St. Louis, MO, to Cape Girardeau, MO; no chlorinated nitrobenzenes (<0.005 ppm) were detected in Mississippi River fish caught above or below this region of the river or in fish from the lower Missouri River, which joins the Mississippi River near St. Louis.

Food and Drug Administration (FDA) personnel use the AOAC official multiresidue method for organochlorine and organophosphorus pesticides (secs. 29.001-29.018 (1)) to analyze foods for many potentially hazardous contaminants besides those for which the method has official status (2). Since 1976, FDA monitoring programs for pesticide and industrial chemical residues in foods have included analyses of selected food samples, mainly of domestic freshwater fish, for residues of electron-capturing industrial chemicals that are recovered in the 6% ethyl ether-petroleum ether eluate of the Florisil cleanup procedure (sec. 29.015 (1)), but are too volatile for electron capture gas chromatography (EC/GC) analysis at the operating conditions recommended in sec. 29.018 (1). EC/GC of these volatile compounds, called "early eluting industrial chemicals" because they elute from the

OV-101 GC column before the residues usually determined by the method, is carried out with the OV-101 column temperature at 130°C instead of the recommended 200°C for pesticides. As part of an ongoing FDA program to identify new or previously unrecognized industrial chemical contaminants of foods, our laboratory investigates food samples that give unidentified analytical responses when monitored for early eluting industrial chemicals at FDA field laboratories.

In one of these investigations, monochloro- and dichloronitrobenzene residues were identified in a sample of Mississippi River buffalofish caught about 60 miles south of St. Louis, MO. The sample was first noted to yield an unidentified EC/GC response in an analysis for early eluting residues at the FDA Minneapolis District laboratory. When the analytical characteristics of the unknown compound were found to differ from those of the compounds listed in an FDA compilation of GC characteristics and AOAC method behavior data for volatile industrial chemicals, the sample was sent to this laboratory for further study. After the residues were tentatively identified as monochloro- and dichloronitrobenzene congeners by GC/mass spectrometry (MS), retention times and recoveries through the nonfatty food extraction and cleanup procedures of the AOAC method (1) were determined for 15 monochloro- through pentachloronitrobenzene congeners. Follow-up analyses of 12 additional fish samples from the Mississippi River and 6 fish samples from the last 300 miles of the Missouri River were performed. Chloronitrobenzenes were found at levels up to about 1 ppm in 7 samples caught in the Mississippi River near or below St. Louis. Residues found included 2-, 3-, and 4-chloronitrobenzene and 2,3- and 3,4-dichloronitrobenzene; their identities were confirmed by GC/MS comparisons with reference standards of the congeners.

Monochloronitrobenzenes have been reported as contaminants of river and drinking waters (3), but neither these compounds nor dichloronitrobenzenes have previously been reported as environmental contaminants of fish or other foods. Annual United States production of

the GC detector oven between the column and separator (9). Glass GC column: 1.8 m \times 2 mm id, packed with 3% OV-101 on 80-100 mesh Chromosorb W (HP). Operating conditions: helium carrier gas 20 mL/min; temperatures ($^{\circ}$ C)—column 130, inlet 150, separator 260, transfer line 220, ion source 150; mass spectrometer pressure 2×10^{-5} torr; filament emission 500 μ A; preamplifier 10^{-7} A/V; 70 eV primary ionizing voltage in EI mode; scanned mass range m/z 33-350; integration time 6 ms/atomic mass unit; data acquisition under computer control.

(e) *Combined gas chromatograph-mass spectrometer (chemical ionization (CI))-data system.*—Finnigan 9600 gas chromatograph/Finnigan 4023T quadrupole mass spectrometer equipped with pulsed positive ion negative ion (NI) CI option/INCOS 2300 data system. The gas chromatograph was directly coupled to the mass spectrometer ion source through a 25 m \times 0.2 mm id OV-101 WCOT flexible fused silica capillary column. Splitless injections were made at the following operating conditions: temperatures ($^{\circ}$ C)—injector 160, column held at 90° for 1 min after injection, then programmed at 15° /min to 150° and held at 150° for 10 min, separator region 160° , transfer line region 115, ion source 250; helium carrier gas head pressure 10 psi; septum sweep (0.8 min after injection) 40 mL/min; methane reagent gas used to increase source pressure to 0.3 torr; electron energy 70 eV; filament emission 0.25 mA. Samples and reference materials were compared in the NI CI mode using multiple ion detection for ions of m/z 35, 37, 127, 129, 157, 159, 161, 163, 191, 193, and 195 with repetitive 1.2 s scans.

Preparation, Extraction, and Cleanup of Fish

Fish were prepared for analysis in accordance with the edible portion guide of the FDA *Pesticide Analytical Manual* (PAM I) (sec. 141.12c (10)). Before extraction, the edible portion of each sample was thoroughly mixed and ground in a meat grinder as described in PAM I (sec. 142.4(5) (10)). Ground fillets of ocean perch were used as the sample substrate in recovery studies. For several fish samples, including ocean perch, the approximate fat content of the edible tissue was determined as in the official fatty food extraction procedure for fish (sec. 29.012(e) (1)).

Residues were extracted from the homogenized fish samples with acetonitrile by using an adaptation of the official extraction procedure for high-moisture nonfatty foods containing <5% sugar (sec. 29.011(a)(1) (1)). This procedure,

which is normally applied to extract 100 g samples of fruits or vegetables, was modified for application to fish of known fat content as described in PAM I (sec. 211.13(f)(2) (10)), i.e., by reducing the sample weight so that the total amount of fat was ≤ 2 g (maximum sample size 50 g). For fish of undetermined fat content, the sample weight used in the nonfatty food extraction procedure was limited to 10-15 g, except for one sample, a carp and sucker fish composite, of which two 20-22 g portions were extracted to obtain enough of the residues for GC/MS analysis.

After the residues were extracted from the fish with acetonitrile, they were transferred to petroleum ether (sec. 29.011(e) (1)), and cleaned up by Florisil column chromatography. The Florisil cleanup procedure (sec. 29.015 (1)) was used without modification for most of the recovery studies with fortified samples of ocean perch; for other analyses of fish, the procedure was modified to elute potential interfering residues from the Florisil column with 100 mL petroleum ether before the usual 6, 15, and 50% ethyl ether-petroleum ether eluates were collected. Each of the eluates was evaporated to ca 5 mL in a Kuderna-Danish concentrator equipped with a Snyder distilling column. For EC/GC analysis, the volume of each concentrated Florisil eluate was adjusted with petroleum ether so that a 3-8 μ L aliquot was equivalent to 20 mg sample. When further concentration of the eluate was required, as for GC/MS analysis, the solvent was evaporated to a suitable volume in a Kuderna-Danish receiver tube equipped with a micro-Snyder column. (Because of the volatile nature of the residues of interest, solvent evaporation under jets of air or nitrogen was avoided.) The 15% ethyl ether-petroleum ether eluates were stored in the dark unless their EC/GC analyses were completed on the same day as the Florisil column cleanup. When these eluates or their concentrates were allowed to stand in normal laboratory light, the "solvent" peaks in their EC chromatograms increased in size as a function of time and became large enough in ca 1 week to obscure the responses for monochloronitrobenzenes.

Gas Chromatography

A 10 μ L syringe was used to inject 3-8 μ L aliquots of the concentrated sample eluates and reference standard solutions for analysis by EC/GC. Retention times of peaks for residues and standards were measured from the solvent peak front and converted to retention times relative to QCB. Peak height was used as the mea-

Table 1. Relative retention times^a of chlorinated nitrobenzenes on packed GC columns^b

Chlorinated nitrobenzene	OV-101	OV-101 + OV-210
3-Chloro	0.23	0.41
4-Chloro	0.25	0.43
2-Chloro	0.25	0.48
3,5-Dichloro	0.37	0.56
2,6-Dichloro	0.40	0.71
2,5-Dichloro	0.42	0.70
2,4-Dichloro	0.45	0.79
3,4-Dichloro	0.50	0.83
2,3-Dichloro	0.51	0.94
2,4,6-Trichloro	0.64	1.00
2,4,5-Trichloro	0.85	1.33
2,3,4-Trichloro	1.03	1.70
2,3,5,6-Tetrachloro	1.37	1.92
2,3,4,5-Tetrachloro	1.80	2.57
Pentachloro	2.97	3.83

^a Relative to QCB.^b Columns: 5% OV-101; 5% OV-101 + 7.5% OV-210 (1 + 1). GC parameters given in Apparatus (c).

buffalofish, a mixture of chlorinated nitrobenzene standards, and the 15% mixed ether eluate of a control sample of ocean perch. The residues indicated by peaks 1 and 2 in the chromatogram of the buffalofish (Figure 1A) eluted from the mixed OV-101 + OV-210 column at the same retention times as 4-chloronitrobenzene and 2-chloronitrobenzene, respectively. When these residues and the corresponding standards (peaks 1 and 2, Figure 1B) were chromatographed on OV-101 columns at 130°C, all eluted at the same retention time. GC/EI-MS comparison of the co-eluting residues with the individual monochloronitrobenzene standards, in combination with the EC/GC retention data, demonstrated that the 15% mixed ether eluate of the buffalofish contained both the 2- and 4-chloronitrobenzene isomers.

The EI mass spectrum of the residue that produced peak 4 in Figure 1A was tentatively identified as that of one or more dichloronitrobenzene isomers. To determine the identity of the specific dichloro isomer(s) and to determine whether other chlorinated nitrobenzenes were present in the sample, the GC characteristics of 15 chloronitrobenzene congeners and the behavior of these compounds in the AOAC nonfatty food extraction and cleanup procedures were investigated.

Table 1 lists the congeners studied and their GC retention times relative to QCB on OV-101 and mixed OV-101 + OV-210 columns at 130°C. (The reported relative retention data are for the columns described in Apparatus (c); virtually the same values were obtained with the more heavily

Table 2. Recovery of chlorinated nitrobenzenes from ocean perch by AOAC pesticide multiresidue extraction/cleanup procedures for nonfatty foods^a

Chlorinated nitrobenzene	Added, ppm	Rec., %	Eluate ^b
2-Chloro	0.50	69, 71	6, 15
	0.050	68, 74	
3-Chloro	0.42	71	15
	0.042	82	
4-Chloro	0.80	80, 80	15
	0.080	79, 83	
2,3-Dichloro	0.25	83, 95	6, 15
	0.025	87, 92	
2,4-Dichloro	0.20	89, 95	6, 15
	0.020	90, 97	
2,5-Dichloro	0.16	104, 116	6
2,6-Dichloro	0.11	88, 101	6
3,4-Dichloro	0.20	86, 90	15
	0.020	87, 92	
3,5-Dichloro	0.11	88, 107	6, 15
2,3,4-Trichloro	0.24	97, 103	6, 15
	0.024	93, 95	
2,4,5-Trichloro	0.45	95, 102	6, 15
	0.045	100, 102	
2,4,6-Trichloro	0.48	101, 102	6
	0.048	103, 103	
2,3,4,5-Tetrachloro	0.36	99, 104	6, 15
	0.036	95, 99	
2,3,5,6-Tetrachloro	0.37	86, 102	6
	0.037	101, 104	
Pentachloro	1.00	84, 102	6
	0.100	100, 103	

^a Nonfatty food extraction cleanup (secs. 29.011(a)(1) and (e) and 29.015 (1)). Extraction modified for fish as in PAM I (sec. 211.13(f)(2) (10)).^b Florisil eluate containing compound: 6 = ethyl ether-petroleum ether (6 + 94); 15 = ethyl ether-petroleum ether (15 + 85).

loaded columns described in Apparatus (b).) The EC responses (peak heights) for the chloronitrobenzenes approximated that of an equal amount of QCB; the ⁶³Ni detector provided about 2-3 times greater response for the chlorinated nitrobenzenes relative to QCB than the ³H detector. The GC retention data for 2 columns indicated that the dichloronitrobenzene isomer in the buffalofish (peak 4, Figure 1A) was 3,4-dichloronitrobenzene. GC/EI-MS comparison of the residue with the standard confirmed this finding.

In studies on the behavior of the chloronitrobenzenes in the AOAC nonfatty food method, the Florisil cleanup procedure (sec. 29.015 (1)) was used without the modification made for the analysis of the Mississippi River buffalofish, i.e., the usual 6, 15, and 50% mixed ether eluates were not preceded by a 100 mL petroleum ether eluate. (The elution with petroleum ether was omitted so that the recovery data would show the eluates in which the compounds would normally be recovered.) Table 2 lists the recoveries of 15

Table 3. Chlorinated nitrobenzenes (ppm) found in edible portion of fish from Mississippi River

Species	Origin ^a	2-Chloro	3-Chloro	4-Chloro	2,3-Dichloro	3,4-Dichloro
Catfish	0	b	b	0.008	b	b
Catfish	0	0.064	c	0.19	b	b
Catfish	0	0.053	c	0.088	b	b
Catfish	0	0.026	c	0.20	b	b
Carp/sucker ^d	0	0.24	0.057 ^e	0.63	0.024	0.085
Buffalofish	60'	0.12	c	0.20	b	0.03
Catfish	150#	0.006	b	0.019	b	b
Catfish	150#	0.027	b	0.025	b	b

^a Fish collection site, in miles south of St. Louis.^b Not detected, limit of quantitation <0.005 ppm.^c GC resolution for analysis was inadequate to detect or determine 3-chloronitrobenzene in presence of 10-fold larger amounts of 4-chloronitrobenzene. If 3-chloro isomer is present in sample, its concentration is estimated as <10% of that of 4-chloro isomer.^d Composite of 2 species.^e Residue value determined using WCOT capillary GLC column.^f Near Kimswick, MO.^g Near Cape Girardeau, MO.

found at the retention times of the 2-chloro-, 3-chloro-, 4-chloro-, 2,3-dichloro-, and 3,4-dichloronitrobenzenes. The presence of these 5 congeners in the 6% mixed ether eluate of the Saugat fish sample was confirmed by comparing the ion current chromatograms obtained for the residues

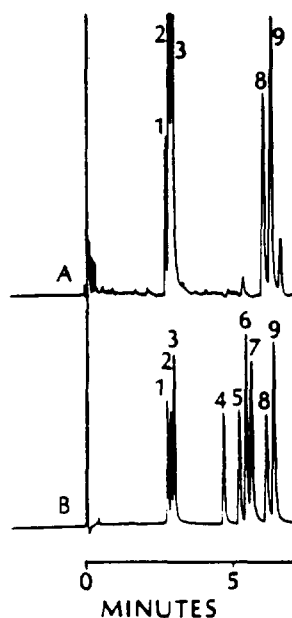


Figure 2. EC (⁶³Ni) gas chromatograms of A, 6% ethyl ether-petroleum ether Florisil eluate of carp/sucker composite (10.5 mg sample equivalent injected); B, mixture of chlorinated nitrobenzene congeners: (1) 3-chloro, (2) 4-chloro, (3) 2-chloro, (4) 3,5-dichloro, (5) 2,6-dichloro, (6) 2,5-dichloro, (7) 2,4-dichloro, (8) 3,4-dichloro, and (9) 2,3-dichloro. OV-101 WCOT capillary column with GC conditions in Apparatus (c).

and reference standards by using capillary GC/MS in the NI CI mode with multiple ion detection of ions characteristic of monochloro- and/or dichloronitrobenzenes (Apparatus (e)).

EC/GC with the ⁶³Ni detector and the mixed OV-101 + OV-210 column described in Apparatus (c) was used to determine the residue levels reported in Table 3, except for 3-chloronitrobenzene, which was determined by using the OV-101 WCOT capillary column. Quantities of compounds found in both the 6 and 15% mixed ether eluates were combined for reporting in Table 3. As shown by Figure 2, the 6% mixed ether eluate of the Saugat fish composite contained 3 compounds which would normally be recovered in the 15% mixed ether eluate, viz., 3-chloro-, 4-chloro-, and 3,4-dichloronitrobenzene. Additional amounts of these compounds (and 2-chloronitrobenzene) were found in the 15% mixed ether eluate; however, this eluate did not contain 2,3-dichloronitrobenzene, a compound which split between the 6 and 15% mixed ether eluates in recovery studies with fortified ocean perch. Although the same lot of Florisil was used as in the recovery studies, the aberrant residue elution pattern was observed for both of the 20-22 g portions of the Saugat fish composite that were processed to obtain enough of the residues for GC/MS analysis. Since the fat content of the composite was not determined, the portions taken for analysis may have contained more than 2 g fat and this, either by itself or in combination with the modification of the Florisil cleanup procedure to use the 100 mL petroleum ether eluate, may have affected the Florisil elution behavior of the residues.

The residue findings reported here indicate

Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants

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Abstract. The organic constituents of mutagenically active secondary effluents from industrial plants and publicly-owned treatment works in Illinois were analyzed by capillary gas chromatography-mass spectroscopy. Tentative identification of 243 compounds, 20 of which are U.S. Environmental Protection Agency priority pollutants, was achieved, including 33 not previously reported as water constituents. Among the compounds detected in one or more of the effluents were aromatic hydrocarbons, phenols, plasticizers, chloro- and bromo-compounds, anilines, indoles, and triazine herbicides. However, only *N*-nitrosodimethylamine and *o*-toluidine, among the identified compounds, are known to be carcinogens or mutagens.

More than 2,000 organic compounds have been reported to be present in natural waters, ground water, drinking water and industrial effluents (Coleman *et al.* 1980; Fine and Rounbehler 1976; Hushon *et al.* 1980; Jungclaus *et al.* 1980; Keith *et al.* 1976; Perry *et al.* 1978; Richardson *et al.* 1980; Shackelford and Keith 1976; Sheldon and Hites 1978, 1979; Zoeteman *et al.* 1980). Little is known about the possible effects of these substances on human or ecosystem health, but in the last few years, reports have appeared on mutagenicity in the organic fractions of drinking water (Loper *et al.* 1978; Nestmann *et al.* 1979; Cheh *et al.* 1980) river water (Pelon *et al.* 1977) and wastewater (Rapaport *et al.* 1979; Saxena and Schwartz 1979). The vast majority of the organic compounds identified in

waters has not been tested for mutagenicity; however 34% of the 71 compounds reported to occur in drinking water and tested by Simmon *et al.* (1977) were mutagens in the *Salmonella* histidine reversion test. In a recent study of secondary effluents from ten municipal and industrial wastewater treatment plants discharging into rivers in Illinois, significant mutagenicity was found in organic concentrates of all effluents; mutagenic activity per liter of effluent varied over a 4500-fold range. The tentative identification by gas chromatography-mass spectrometry (GC-MS) of 243 organic compounds from these effluents is reported herein.

Methods

Site selection and sampling: Sites were selected and samples were collected by the staff of the Division of Water Pollution Control of the Illinois Environmental Protection Agency. A few composite samples were collected with a syringe-activated sampling pump, but most were grab samples. Emphasis was given to secondary effluents from municipal treatment plants receiving industrial discharges as part of the influent, and one sample of wholly municipal effluent. Table 1 describes the sites sampled and provides information on the collection of samples. The Illinois Pollution Control Board's Rules and Regulations require that effluent discharged in Illinois shall not exceed a level of 400 fecal coliforms per 100 ml, which requires municipal wastewater treatment plants to disinfect most plant effluents. Chlorination is the most common method used to meet this requirement. Among the effluents sampled, samples 1, 9, and 10 were not disinfected; no disinfection was practiced at these plants. All of the others were chlorinated with Cl₂. A telephone survey of the plants that chlorinate revealed a variety of free chlorine residuals ranging from 0.2 to 0.9 ppm. Disinfection by chlorination could increase the mutagenic activity of the effluent or if the free available chlorine residuals are high, weak mutagenic activity might be created by reaction of the chlorine with the XAD resins used for

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Table 1. Location and description of sampling sites in Illinois

Sample no.	Date; hr	Location	Remarks
1	22 Feb 80	Refinery, Lockport	Grab sample of oil refinery final effluent
2	20 Mar 80; 9:00–16:30	St. Charles POTW ^a	Sample was ½ grab and ½ 8 hr. composite, by vol., final effluent
3	17 Apr 80; 13:30	Addison POTW	Grab sample of final effluent
4	29 Apr 80; 11:00	Bartlett POTW	Grab sample of final effluent
5	16 May 80	Roselle POTW	Grab sample of final effluent (Trickling filter plant partially inoperative)
6	28 May 80; 10:00	Danville POTW	Grab sample of final effluent
7	5 June 80; 14:00	Decatur POTW	Grab sample of final effluent
8	13 June 80; 17:00–23:30	Bensenville POTW	Composite sample taken at weir at chlorine contact tank nearest to discharge line
9	20 June 80; 16:00–23:00	Sauget POTW	Composite sample ^b taken at first manhole downstream of treatment process
10	26 June 80; 13:30–20:30	Industrial plant at Lawrenceville	Composite sample ^c taken at weir of final settling pond prior to process outfall

^a POTW = Publicly Owned Treatment Works

^b Sample was deep yellow to amber in color and slightly odorous. A substantial solid accumulate appeared on the glasswool plug on the influent side of the XAD-2 resin tube

^c Sample had an "organic odor" and showed patches of oil on its surface. Part of the effluent came from chlorinated process water

sample workup. However, the mutagenicities of the effluents appeared unrelated to chlorination. Chlorinated compounds did not predominate in any sample, and among the four most mutagenic effluents, two had been chlorinated and two had not.

Total Organic Carbon: A Dohrmann DC-54 apparatus was used for the determination of total dissolved organic carbon after filtering the samples through baked glass fiber ultra-filters. Two or three replicates were run for each sample; the values agreed within 10%.

Solvent Extraction: The solvent extraction procedure used in U.S. Environmental Protection Agency (EPA) protocols (adjustment of sample pH to 11, extraction with CH_2Cl_2 , readjustment of pH to 2, extraction with CH_2Cl_2) was modified; the second extraction was performed at pH 6 so that phenolic compounds would be protonated and presumably extractable in this step, whereas carboxylic acids would remain in the anionic form and remain in the aqueous layer. The carboxylic acids were concentrated on XAD-8 resin. To minimize contamination, all glassware was washed with detergent, rinsed with distilled water and acetone, baked at 350°C overnight, and covered with aluminum foil during storage. Apparatus contained Teflon stopcocks.

The pH of each effluent sample (32 L) was adjusted to 11 with 4 M KOH in the field. During this operation, precipitates sometimes formed; if so, the sample was carefully decanted, so that particulate material was not disturbed at the bottom of the container. The decanted sample was extracted at pH 11 with CH_2Cl_2 (40 ml CH_2Cl_2 /L sample). The extraction apparatus consisted of three parts (a 4-L flask, a fritted glass filter unit and a 1000-ml separatory funnel) interconnected by standard taper joints. The aqueous sample containing CH_2Cl_2 was magnetically stirred for

10 min with the flask in its normal position; the filter unit (designed to break emulsions) was then affixed on top of the flask followed by inversion of the entire assembly. The CH_2Cl_2 layer was drained through the glass filter of the unit and collected in the separatory funnel for further processing. After the first extraction, the organic layer was removed and the sample was reextracted, a process repeated three times. After the last extraction at pH 11, the pH of the sample was adjusted to pH 6 with 11.7 M HCl. The pH 6 sample was again extracted four times with CH_2Cl_2 . The aqueous fraction was discarded; the CH_2Cl_2 fractions, dried with MgSO_4 , were concentrated to 200 ml by rotary evaporation and 100 ml of the concentrate was further evaporated to a final volume of 0.5 ml for GC/MS analysis.

Resin Sorption: All samples were also fractionated by two Rohm and Haas resins, XAD-2 and XAD-8. Resin XAD-2, a macroporous polystyrene, is highly useful in concentration of nonpolar organic compounds from dilute aqueous solution (Burnham *et al.* 1972), whereas XAD-8, a polyacrylate, is especially useful for polar compounds such as carboxylic acids (Thurman *et al.* 1978). Resins were purified by methods based on those of Junk *et al.* (1974) and Thurman *et al.* (1978). Eighty g of Amberlite XAD-2 or XAD-8 were washed with 200 ml of 2% ammonium carbonate for twenty min. The resins were rinsed with 500 ml of distilled water after the ammonium carbonate wash and extracted sequentially in a Soxhlet apparatus with water, methanol (glass-distilled), and diethyl ether (reagent grade). The volume of each solvent was 300 ml; resins were refluxed 24 hr in each solvent. At the end of the ether reflux, resins were rinsed successively with 200 ml of methanol and 1000 ml of glass-distilled water. The aqueous slurry of the resins was stored in glass bottles with glass stoppers; the slurry was not allowed to become dry. XAD-2 and XAD-8 were packed into separate columns with

bed volumes of 59 ml (the length and the diameter of the columns were 12 cm and 2.5 cm, respectively). After packing, resins were washed thoroughly with glass-distilled water before use. All resins were used only once. Each aqueous sample (32 L) was passed through an XAD-2 column (either by gravity or by means of a mechanical syringe pump) at a rate of 50 ml/min, discarding the eluate. After the aqueous sample was passed through the column, sorbed organic compounds were eluted with 200 ml of diethyl ether. A portion of the ether fraction (100 ml), after drying with MgSO_4 , was concentrated to 0.5 ml by rotary evaporation and set aside for GC/MS analysis. The remainder of the fraction was reserved for mutagenicity testing.

The pH of another 32 L of aqueous sample was adjusted to pH 2 with 11.7 M HCl in the field. After arrival in the laboratory, the sample was run through an XAD-8 column either by gravity or by a syringe pump at a rate of 50 ml/min. The column was eluted with 200 ml of 0.05 M NH_4OH . A portion of the eluate (100 ml) was lyophilized to dryness. The resulting powder was dissolved in 5 ml of methanol before methylation with CH_3N_2 . The methylated sample was concentrated to 0.5 ml by rotary evaporation before GC/MS analysis.

GC/MS Analysis: Gas chromatography for all ten samples was done on a 30-m high-resolution SP-2100 coated glass capillary column (Supelco Inc.; AA grade; internal diameter 0.32 mm) in a Hewlett-Packard 5730 gas chromatograph. The carrier gas was helium at a flow rate of 1.8 ml/min; the injection port temperature was 200°C. Splitless, on-column injection techniques were used; sample injection size was normally 1.0 μl . Temperature was programmed from 40°C (after a 5-min. hold) to 240°C at 3°/min. and held at 240°C for 50 min. Compounds were detected by a quadrupole mass spectrometer (Hewlett-Packard 5985) as a total ionization detector. The quadrupole was tuned daily using perfluorotributylamine as a standard. The performance of the GC column was checked periodically with the use of standard mixtures of EPA priority pollutants (Supelco Inc.). The use of these mixtures allowed the identification of the compounds (when present in the effluent samples) with a high degree of confidence by comparison of their retention times and mass spectra with those of the standards under nearly identical conditions. Similar standard mixtures, supplied by Supelco, Applied Science Laboratories, and Alltech permitted the identifications of the *n*-alkanes, fatty acids, and some of the alcohols, ketones, and phenolic compounds (Table 3). Decadeuterioanthracene was used as an internal standard in some samples.

Other compounds were tentatively identified by a combination of computerized peak matching and examination of standard reference mass spectra (Mass Spectrometry Data Centre 1974; Stenhagen *et al.* 1974). The peak matching procedure was seldom of value in the process, and in no case was peak matching alone accepted as evidence for the identification of a compound.

Results and Discussion

Total Organic Carbon: Dissolved organic carbon concentrations are listed in Table 2. They ranged from 9 mg/L for effluent 5 to 152 mg/L for effluent 9. (All of samples 1, 3, and 4 were consumed by the fractionation procedures; no TOC analyses of these samples were made).

Table 2. Total organic carbon (TOC) in unfractionated effluents

Sample	TOC (mg/L)
Effluent 2 (St. Charles)	17
Effluent 5 (Roselle)	9
Effluent 6 (Danville)	16
Effluent 7 (Decatur)	19
Effluent 8 (Bensenville)	12
Effluent 9 (Sauget)	152
Effluent 10 (Lawrenceville)	22

Individual Compound Identification: The analysis of the ten effluent samples resulted in the tentative identification of 243 organic compounds. A complete list of all compounds tentatively identified and their frequency of occurrence is shown in Table 3; 74 were categorized as hydrocarbons, 49 alcohols and phenols, 17 aldehydes and ketones, 27 acids and esters, 15 ethers, 20 halogen compounds, 37 nitrogen compounds, and 4 others. Some compounds had more than one functional group; the total number of compounds in several of the above categories would be somewhat greater if this was taken into account.

Twenty of the compounds were U.S. EPA priority pollutants (Table 4). The occurrence of most of the compounds was scattered, but naphthalene occurred in 8 of the 10 effluents. Dichlorobenzenes also were detected in 7 of the 10 effluents; of the remaining priority pollutants, only C_2 -benzenes, dibutyl phthalate, and nitrobenzene occurred in as many as 4 of the 10 samples. Thirty-three of the 243 compounds tentatively identified have not previously been reported as constituents of natural water, drinking water, or wastewaters. Only 17 of the compounds (or groups of isomeric compounds) were detected in four or more of the effluents; *n*-tetradecane in 4, xylene isomers in 4, C_3 -alkylbenzenes in 5, benzaldehyde in 4, 1,3-dioxolanes in 4, lauric acid in 4, nitrobenzene in 4, acetaminophen in 4, cresol isomers in 4, benzothiazole in 5, 2-(methylthio)benzothiazole in 5, dibutyl phthalate in 6, C_1 -naphthalenes in 6, dichlorobenzenes in 7, C_4 -alkylbenzenes in 6, naphthalene in 8, and BHT in 9. The majority of the compounds (148 out of 243) occurred only once. The individual samples were widely different in terms of the number of identifiable compounds present, ranging from only 11 in effluent #2 (St. Charles) to 71 in effluent #10 (Lawrenceville).

Sample 1 (Lockport): This sample, taken from a petroleum refinery, contained a variety of compounds ranging from hydrocarbons to triazine her-

Table 3. Tentative identification and frequency of occurrence of compounds detected in municipal and industrial effluents

Hydrocarbons (74) ^a	Number of isomers ^a	Number of times detected ^b	Previously reported ^c	Effluent no.
C ₅ H ₁₀	1	1	+	9
C ₉ H ₂₀	1	1	+	1
C ₁₀ H ₁₈	1	1	+	5
C ₁₀ H ₂₂	1	1	+	1
C ₁₂ H ₂₆	1	1	+	10
C ₁₃ H ₂₈	1	1	+	10
C ₁₄ H ₂₈	1	1	+	4
C ₁₄ H ₃₀	2	3	+	1,3,10
C ₁₅ H ₃₂	2	2	+	1,10
C ₁₆ H ₃₂	1	1	+	10
C ₁₆ H ₃₄	1	1	+	10
C ₁₇ H ₃₆	3	2	+	1,10
C ₁₈ H ₃₈	3	3	+	1,3,10
C ₁₉ H ₄₀	1 ^e	2	+	3,10
C ₂₀ H ₄₀	1	1	+	5
C ₂₀ H ₄₂	2 ^f	2	+	1,10
C ₂₁ H ₄₄	1	1	+	10
C ₂₂ H ₄₆	1	1	+	10
C ₂₃ H ₄₄	1	1	+	10
C ₂₃ H ₄₆	1	1	+	10
C ₂₄ H ₄₈	1	1	+	4
Isopropylcyclohexane	1	1	-	3
Toluene	1	3	+	1,3,4
C ₇ -Benzenes	3	4	+	1,3,9,10
C ₃ -Benzenes	6	5	+	3,7,8,9,10
C ₄ -Benzenes	9	6	+	3,6,7,8,9,10
C ₅ -Benzenes	3	3	+	7,10
C ₆ -Benzenes (monounsaturated or monocyclic)	1	1	+	7
Indene	1	1	+	9
C ₇ -Indene	1	1	+	10
Indan	1	1	+	3
C ₁ -Indan ^g	2	2	+	3,9
C ₂ -Indan ^g	1	2	+	7,10
C ₃ -Indan ^g	1	2	+	7,8
C ₄ -Styrene	2	2	+	6,10
Naphthalene	1	8	+	1,3,4,5,6,7,8,9
C ₁ -Naphthalenes	2	6	+	3,5,6,7,8,9
C ₂ -Naphthalenes	2	2	+	3,7
C ₃ -Naphthalenes	2	1	+	10
C ₄ -Naphthalenes	2	1	+	10
C ₂ -Tetrahydronaphthalene	1	1	+	3
C ₁ -Biphenyl	1	1	+	3
C ₂ -Fluorene	1	1	+	3
Phenanthrene	1	1	+	8
<i>Alcohols, phenols (49)</i>				
Butanol	1	1	+	1
2-Methyl-2-butanol	1	1	+	1
1-Hexanol	1	1	+	1
2-Hexanol	1	1	+	1
3-Hexanol	1	1	+	1
2-Hydroxy-2-methyl-4-pentanone	1	1	+	3
C ₁ -Heptanol	2	1	+	4
α-Terpineol	1	3	+	2,3,5
Linalool	1	1	+	3
Fenchyl alcohol	1	1	+	9
Borneol	1	1	+	9
Camphene hydrate	1	1	-	6
Terpinen-4-ol	1	1	+	3
Eugenol	1	1	+	3

Table 3. (cont'd)

	Number of isomers ^a	Number of times detected ^b	Previously reported ^c	Effluent no.
Thymol	1	2	+	6,10
Carvacrol	1	1	-	10
Benzyl alcohol	1	2	+	3,9
Phenol	1	2	+	1,9
C ₁ -Phenols	2	4	+	3,5,7,9
C ₂ -Phenols	1	1	+	10
C ₃ -Phenols	3	1	+	10
C ₄ -Phenols	3	1	+	10
2-Chlorophenol	1	1	+	9
Dichlorophenols	2	1	+	9
2,4,6-Trichlorophenol	1	2	+	6,9
Tetrachlorophenol	1	1	+	9
Pentachlorophenol	1	1	+	9
Bromophenol	1	1	+	9
<i>m</i> - or <i>p</i> -Nitrophenol	1	1	+	9
<i>o</i> -Nitrophenol	1	1	+	9
BHA	2	3	+	3,5,7
BHT	1	9	+	1-8,10
<i>p</i> -Propoxyphenol	1	2	+	5,6
<i>p</i> - <i>t</i> -Amylphenol	1	1	-	5
<i>p</i> -Tetramethylbutylphenol	1	3	+	5,7,8
Methyl- <i>t</i> -butylphenol	1	3	+	4,5,6
<i>p</i> -Dimethylpropylphenol	1	1	-	7
<i>o</i> -Phenylphenol	1	2	+	7,8
Nonylphenol	2	1	+	7
<i>p</i> - <i>t</i> -Butylphenol	1	2	+	7,9
<i>Aldehydes, Ketones (17)</i>				
2-Methyl-3-pentanone	1	1	+	1
2-Methyl-2-pentanone	1	3	-	3,4,5
4-Methyl-3-pentan-2-one	1	1	+	1
3-Hexanone	1	1	+	1
4,4-Dimethyl-2-pentanone	1	1	+	1
3-Heptanone	1	1	+	1
Cyclohexenone	1	1	-	6
Pent-3-en-4-one	1	1	+	1
3-Methyl-2-butanone	1	1	-	1
5-Phenyl-5-methyl-2-hexanone	1	1	-	8
2,6-Di- <i>t</i> -butylbenzoquinone	1	1	+	5
Benzaldehyde	1	4	+	3,4,6,7
Vanillin	1	1	+	6
Acetophenone	1	2	+	5,9
C ₁ -Acetophenone	1	2	+	9
Benzophenone	1	3	+	3,5,6
Fluorenone	1	2	+	3,9
<i>Carboxylic acids, esters (27)</i>				
Acetic acid	1	2	+	7,8
2-Pentenoic acid	1	1	-	2
Octanoic acid	1	1	+	3
Nonanoic acid	1	1	+	3
Decanoic acid	1	3	+	2,3,7
Lauric acid	1	4	+	2,3,7,9
Myristic acid	1	3	+	2,3,7
Branched C ₁₄ acid	1	1	-	7
Branched C ₁₅ acids	2	1	-	7
Unsaturated C ₁₅ acids	2	1	-	7
Palmitic acid	1	3	+	2,3,8
Palmitoleic acid	1	1	+	7

Table 3. (cont'd)

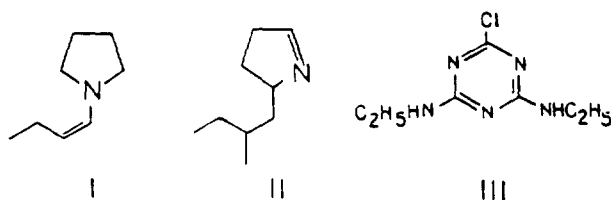
	Number of isomers ^a	Number of times detected ^b	Previously reported ^c	Effluent no.
Branched C ₁₆ acid	1	1	—	10
Stearic acid	1	1	+	3
Benzoic acid	1	1	+	3
C ₇ -Benzoic acid	1	1	+	10
C ₈ -Benzoic acid	1	1	+	10
Salicylic acid	1	1	+	9
Phenylacetic acid	1	1	+	3
Phenylpropionic acid	1	1	+	3
Ethyl acetate	1	1	+	1
Ethyl 2-hydroxy-2-phenylacetate	1	1	—	6
Diethyl phthalate	1	2	+	3,5
Dibutyl phthalate	1	6	+	3,5,6,7,8,10
Di(2-ethylhexyl)phthalate	1	1	+	3
<i>Ethers (15)</i>				
Ethyl isopropyl ether	1	1	+	1
Diphenyl ether	1	1	+	7
1,3-Dioxolanes	4	4	+	1,5,6,7
Dibutoxymethanes	2	1	—	3
Dipropylene glycol methyl ether	2	3	+	6,7,10
Tripropylene glycol methyl ether	1	1	—	6
Tetrapropylene glycol methyl ether	2	1	—	5
2,2-Dimethoxy-1-phenylethane	1	1	—	5
1,4-Dioxaspiro(4,5) decane	1	1	—	6
<i>Halogenated compounds (20)</i>				
Dibromochloromethane	1	1	+	4
Bromoform	1	1	+	4
Tetrachloroethylene	1	3	+	3,5,7
3-Bromocyclohexene	1	1	—	4
3-Chlorocyclohexene	1	1	+	4
Chlorobenzene	1	2	+	1,9
Bromobenzene	1	1	+	9
Dichlorobenzenes	2	7	+	3,4,5,6,7,8,9
Chlorotoluenes	2	1	+	9
Chlorinated C ₂ -benzene	1	1	+	9
Chloroanilines	2	1	+	9
Chloronitrobenzenes	2	1	+	9
Dichloroaniline	1	1	+	9
Dichloronitrobenzene	1	1	+	9
Trichloroaniline	1	1	+	9
1-Nitro-3-bromo-4-aminobenzene	1	1	—	9
<i>Nitrogen compounds (37)</i>				
Dimethylnitrosamine	1	1	+	3
Diethylaminoethanol	1	1	+	7
C ₁ -Pyrrole	1	1	+	6
Glycine	1	2	+	1,2
C ₁ -Pyridine	1	1	+	9
C ₂ -Pyridine	1	1	+	7
C ₄ -Pyridine	1	1	+	9
Nitrobenzene	1	4	+	1,3,6,9
Aniline	1	1	+	9
C ₂ -Aniline	1	2	+	9,10
Ethoxyaniline (phenetidine)	1	1	—	9
Formanilide	1	1	—	9
Nitroaniline	1	2	+	6,9
o-Toluidine	1	1	+	10
Acetaminophen	1	4	+	2,3,5,6

Table 3. (cont'd)

	Number of isomers ^a	Number of times detected ^b	Previously reported ^c	Effluent no.
Nicotine	1	1	+	3
<i>p</i> -Nitrophenetole	1	1	-	9
<i>N,N</i> -Dimethyl- <i>p</i> -toluenesulfonamide	1	1	-	1
1-Azolidin-1-yl-1-butene	1	1	-	1
2-(1-Pyrrolidinylmethylene)-butane	1	1	-	1
Indole	1	1	+	3
3-Methylindole	1	1	+	3
<i>C</i> ₇ -Indole	1	1	+	10
<i>N,N</i> -Dimethylbenzylamine	1	1	-	7
<i>N</i> -Phenyl- α -methylbenzylamine	1	1	-	9
<i>C</i> ₇ -Quinoline	1	1	+	10
2-Methylquinoxaline	1	1	-	7
Caffeine	1	1	+	2
Diazinon	1	1	+	3
Prometone	1	1	+	1
Simazine	1	1	+	1
1,3,5-Trimethyl-2,4,6-trihydroxytriazine	1	1	+	9
Benzothiazole	1	5	+	3,5,6,7,8
2-(Methylthio)-benzothiazole	1	5	+	2,3,5,6,7
Benzothiadiazole	1	1	+	6
Diphenylamine	1	1	+	9
Nitrodiphenylamine	1	1	-	9
Other (4)				
Tributyl phosphate	1	3	+	5,6,7
2-Thiaindan	1	1	-	7
Benzo-2,3-thiophene	1	1	+	10
Methylbenzo-2,3-thiophene	1	2	+	7,10

^a Number of isomers actually detected in all samples. ^b Number of samples containing at least one of the isomers. ^c A + sign means the compound (or at least one isomer) has previously been reported to occur in water. ^d Number in parentheses is the number of compounds in this class tentatively identified in all samples. ^e Probably pristane. ^f One isomer is probably phytane. ^g Compounds identified as alkylindans may also be alkyltetrahydronaphthalenes with one less alkyl group

bicides. The pH 11 extract contained a number of alcohols and ketones; the largest peaks in the mass



spectrum were due to toluene, 2-methyl-3-pentanone and 3- and 2-hexanol. Small peaks for chlorobenzene, nitrobenzene, and phenol were noted. Two unusual and related nitrogen heterocycles, 1-(azolidin-1-yl)1-butene (I) and 2-(1-pyrrolidinylmethylene)-butane (II) were tentatively identified on the basis of strong similarities between their spectra and those recorded in Stenhagen *et al.* (1974). Two triazine herbicides, simazine (III) and prometone (IV) were also present in this extract; the former compound was also identified in the XAD-2 eluate. The pH 6 extract contained phenol

as its major constituent (based on total ion chromatogram peak size) and lesser amounts of chlorobenzene, BHT, and several other compounds. The XAD-2 eluate included the previously mentioned simazine (III), nitrobenzene, and 3-methyl-2-bornanone (V), a naturally occurring ketone related to camphor. The XAD-8 eluate showed only a few peaks; the methyl ester of glycine and *N,N*-dimethyl-*p*-toluenesulfonamide were the only compounds which could be identified.

Sample 2 (St. Charles): This treatment plant serves some 80 industrial clients, including manufacturers of ink, processed foods, metal stampings, furniture and cabinets. However, the effluent gave a general impression of being relatively clean. Only 11 compounds were tentatively identified. In the pH 11 extract, acetaminophen (an analgesic drug) and 2-(methylthio)benzothiazole were the major constituents. Small amounts of α -terpineol (a monoterpene alcohol) and caffeine (a constituent of coffee, tea, and cola beverages) were also present.

Table 4. EPA priority pollutants identified in effluent samples

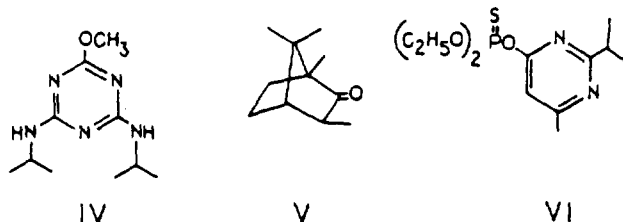
Compound	No. effluents
Toluene	3
C ₇ -benzenes ^a	4
Naphthalene	8
Phenanthrene	1
Phenol	2
Dimethylphenols ^a	1
Dichlorophenols ^a	1
2,4,6-Trichlorophenol	2
Pentachlorophenol	1
<i>o</i> -Nitrophenol	1
Diethyl phthalate	2
Dibutyl phthalate	6
Di(2-ethylhexyl) phthalate	1
Dibromochloromethane	1
Bromoform	1
Tetrachloroethylene	3
Chlorobenzene	2
Dichlorobenzenes ^a	7
Dimethylnitrosamine	1
Nitrobenzene	4

^a One or more isomers are priority pollutants

The pH 6 extract contained no identifiable compounds. The compounds in the XAD-2 eluate were very similar to those in the pH 11 extract; the XAD-8 eluate contained mostly fatty acids.

Sample 3 (Addison): At least 300 industrial and manufacturing firms, including manufacturers of printing ink, plastics, chemicals, metals and machinery, paper products, snack foods, adhesives, industrial lubricants, aerosols, rubber products, and cosmetics, discharge their wastes to this plant. The only organic pollutants reported by these firms to the Illinois Environmental Protection Agency in their inventory of industrial dischargers to municipal treatment works were toluene and chlorinated ethanes. The plant effluent was badly contaminated, containing a great variety of hydrocarbons, oxygenated compounds, an *N*-nitrosamine and a herbicide. The pH 11 extract was dominated by alkylated benzenes (17 isomers); benzyl alcohol, 3-methylindole (skatole, a constituent of feces), and acetaminophen contributed other large peaks. Tetrachloroethylene, a dichlorobenzene, *p*-cresol, nicotine, benzophenone, and fluorenone were important smaller peaks. The pH 6 extract was dominated by *p*-cresol, but benzyl alcohol and BHT also gave large signals. The XAD-2 extract contained many alkylbenzenes and alkyl-naphthalenes. Acetaminophen and tetrachloroethylene also gave large signals. The pesticide diazinon (VI) was present as a medium-size peak at 50.6 min. The methylated XAD-8 extract contained mostly methyl esters of fatty and aromatic carboxylic acids (lauric acid

was the most abundant), but a small early peak gave an excellent match in both the Mass Spectral Data Centre Index (1974) and Stenhagen *et al.* (1974) for



dimethyl-*N*-nitrosamine. This compound, a known carcinogen, has been identified before in water, first in the polluted Baltimore Harbor (Fine and Rounbehler 1976) and later in sewages and industrial effluents (Richardson *et al.* 1980).

Sample 4 (Bartlett): This effluent had been chlorinated. It was the only purely municipal effluent sampled. Typical water-chlorination volatile constituents (haloforms) appeared in the pH 11 extract; dibromochloromethane, emerging at 5.8 min., was much more abundant than bromoform (9.2 min). Other haloforms, if present, were too volatile to be detected with our procedure. Benzaldehyde, 3-chlorocyclohexene, and BHT were among the most abundant compounds tentatively identified in the pH 11 extract. Dibromochloromethane was also present in the XAD-2 eluate.

Sample 5 (Roselle): This plant served less than 20 industrial users and had the lowest dissolved organic carbon content of any tested; however, it contained phenols, plasticizers, long-chain glycol ethers, and chlorinated compounds. The industries reported that they discharged benzene, phenol, and "oil and grease". The pH 11 extract contained many highly substituted phenols, including *t*-butyl cresol, *p*-*t*-amylphenol, BHA, BHT and *p*-tetramethylbutyl phenol. The XAD-2 eluate contained the latter phenol also, as well as benzophenone, 2,6-di-*t*-butylbenzoquinone, acetophenone, a dichlorobenzene, and two phthalate esters.

Sample 6 (Danville): About 100 industries discharged to this plant. They included manufacturers of plastic containers, cardboard, machinery, foods and feeds, fireworks, fertilizers, and refrigerants, an iron foundry, a lithographic plater and metal-finishing and electroplating firms. The industries reported to the Illinois Environmental Protection Agency that they discharged "oil and grease", phenol, toluene and PCBs. The plant effluent contained a wide variety of compound types. The most

abundant compound (based on the total ion chromatogram) in the pH 11 extract was the analgesic acetaminophen. Benzophenone, tributyl phosphate and methyl-*t*-butylphenol were also present. The pH 6 extract contained cyclohexanone, a methylpyrrole, naphthalene, thymol and dibutylphthalate, among other compounds. The XAD-2 eluate again contained a large peak for acetaminophen and also contained substantial amounts of benzothiazole. Smaller amounts of dichlorobenzene, nitrobenzene, trichlorophenol, nitroaniline, and benzophenone were detected.

Sample 7 (Decatur): The industrial users of the Decatur plant reported that they discharged naphthalene, chloroform, nitrosamines, toluene, benzene, chlorinated ethanes, isophorone, phenol, and "oil and grease." Industries included a metal works, a meat packer, a newspaper, a laundry and linen supply dealer, and manufacturers of auto polishes, valves, tires, and ice cream. The effluent contained a great number of compounds; alkylated aromatic hydrocarbons and phenols were particularly abundant. The largest peak in the total ion chromatogram of the pH 11 extract was due to *p*-(tetramethyl-butyl)-phenol. *o*-Phenylphenol, *p*-(1,1-dimethyl-propyl)-phenol, BHA, and BHT also had large signals. Small quantities of tetrachloroethylene, a dichlorobenzene and alkylated benzenes and naphthalenes were also detected in this extract. The pH 6 extract had large peaks for *p*-cresol and also for C₁₂, C₁₄, and C₁₅ free fatty acids.

Sample 8 (Bensenville): Although about 200 industrial firms discharged to the Bensenville plant (including manufacturers of electronic components, foods, cosmetics, petroleum and rubber products, pigments, and a large brewery), not many compounds were identified in its effluent. Almost all of them were in the XAD-2 eluate; no single substance predominated, and there were numerous small peaks, including alkylated benzenes and naphthalenes, phenanthrene, dichlorobenzene, and two phenols.

Sample 9 (Sauget): The influent to the Sauget plant was dominated by the wastes of a heavy chemical plant, although manufacturers of alloys and metal tubing also contributed. The effluent contained many compounds (substituted anilines and nitro compounds) not identified in any other sample; many of them have not previously been reported to occur in water. The pattern is suggestive of azo dye manufacturing wastes. Material particularly abundant in the pH 11 effluent included chlorobenzene, C₂-benzene, aniline, dichloroben-

zenes, chloronitrobenzenes, and free salicylic acid, but there were many other amino-, nitro-, chloro-, and alkylsubstituted aromatic compounds present in apparently lower abundance. Particularly interesting compounds in the XAD-2 eluate were diphenylamine and a nitro-substituted isomer, a dichloronitrobenzene (abundant), and fluorenone. The pH 6 extract contained phenol, *o*-chlorophenol, *o*-cresol, *o*-nitrophenol, dichlorophenols, and a bromophenol. Even more highly substituted phenols were inferred from the (methylated) XAD-8 eluate; the methyl ethers of trichloro-, tetrachloro- and pentachlorophenol were detected. The methyl ether of nitrophenol was the largest peak in the total ion chromatogram.

Sample 10 (Lawrenceville): This effluent, from a petroleum refinery, was highly complex, but most of the substances present were hydrocarbons. Approximately 70 compounds were identified; there were many unknown peaks. In the pH 11 effluent, the most interesting tentative identification was that of *o*-toluidine, generally considered to be a carcinogen or at least procarcinogenic (Weisburger and Poirier 1979). The largest peak in the spectrum, however, was a C₁₈H₃₈ alkane. Substituted benzenes with two to five alkyl carbons formed a long series in this fraction, and also in the XAD-2 eluate. The methylated XAD-8 eluate contained, in addition to alkanes and fatty acid methyl esters, substituted benzoic acids with two and three alkyl carbon substituents. Neither substance has been reported from water before; they may be microbial metabolites of alkylbenzenes. The C₂-benzoic acid was the most abundant compound in the total ion chromatogram.

Conclusions

Only a very small number of the compounds identified in this study of mutagenic effluents are known or suspected mutagens, promutagens or carcinogens. However, most of the individual compounds have not been tested for genetic activity. Furthermore, since the concentrates were tested for mutagenicity as a whole, there are many possibilities for synergistic effects among their components. It is also possible that active mutagens may not lend themselves to GC-MS analysis because of involatility, thermal instability, or reactivity with the support material. Finally, many of the peaks observed in these complex samples simply cannot be identified at this time. However, more sophisticated separation schemes, undertaken in conjunction with bioassays, may lead to positive identification of new waterborne mutagens in future studies.

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Manuscript received June 20, 1981; accepted September 1, 1981.

Log 86-293

VILLAGE OF SAUGET
SANITARY DEVELOPMENT AND RESEARCH ASSOCIATION
10 MOBILE STREET
SAUGET, ILLINOIS 62201

1630200005 STCLA
SAUGET
superfund/Technical

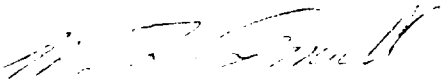
September 30, 1986

Mr. Jeff Larson
Federal Site Management Unit
Remedial Project Management
Division of Land Pollution Control
Illinois Environmental Protection Agency
2200 Churchill Road
Springfield, Illinois 62706

Dear Mr. Larson:

Enclosed is a copy of the Geologic Log of Monitoring Wells, Summary of Construction Details for Monitoring Wells, and the Well Location Map relative to the Sauget Sanitary Development and Research Association groundwater study. This is in response to your verbal request for this information.

Sincerely,



Warren L. Smull

/bjj
Enclosures

Enclosure is in working file

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GEOLOGIC LOGS OF MONITORING WELLS
ON SAUGET SANITARY DEVELOPMENT AND
RESEARCH ASSOCIATION PROPERTY
SAUGET, ILLINOIS

<u>Description</u>	<u>Depth (feet)</u>
<u>Wells GM-19ABC</u>	
Silt, sandy, brown (fill)	0 - 12
Silt, clayey, sandy, gray	12 - 25
Sand, fine, silty, grayish-brown	25 - 60
Sand, fine to medium, gray; some silt, trace of gravel with cobbles (75-113 feet)	60 - 113
<u>Wells GM-20AB</u>	
Sand, fine, gray, (fill)	0 - 3
Sand, fine, silty gray	3 - 15
Sand, fine, brown; some silt	15 - 26
Clay, gray; trace of fine sand	26 - 28
Sand, fine, silty, gray; some medium sand with thin silt seams	38 - 38
Sand, fine, gray; some silt	38 - 60
Sand, fine to medium; gray	60 - 70
Sand, fine to coarse; gray; with fine to medium gravel	70 - 90
<u>Wells GM-21AB</u>	
Sand, fine, brown; some silt	0 - 20
Sand, fine to medium, brown; some silt	20 - 39
Sand, fine to medium, brown; trace of silt; trace of gravel	39 - 45
Sand, fine to coarse, brown; trace of gravel	45 - 70
Gravel, fine to medium; with coarse to fine brown sand	70 - 88
<u>Wells GM-22-AB</u>	
Silt, sandy, brown (fill)	0 - 10
Sand, very fine, silty, grayish-brown	10 - 20
Sand, fine, gray; some silt	20 - 38.5
Sand, very fine to fine, gray; little silt	38.5 - 70
Sand, fine to medium, grayish-brown; little fine gravel	70 - 88

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Description(feet)Well GM-23

Sand, fine, silty, brown	0 - 31
Sand, fine, brown; some medium sand and silt	31 - 38

Wells GM-24AB

Sand, very fine, very silty, brown	0 - 15
Sand, fine, brown; little silt	15 - 36
Sand, fine to medium, brown; little silt	36 - 68
Sand, fine to medium, gray; some coarse sand and fine gravel	68 - 79
Sand, fine to coarse, gray; some fine to medium gravel, little silt	79 - 88

Wells GM-26AB

Sand, fine, brown (fill)	0 - 12
Sand, fine to coarse, brown, with gravel (fill)	12 - 16
Silt, brown; some gravel	16 - 24
Sand, fine to coarse, gray; with gravel	24 - 40
Silt, sandy, gray	40 - 58
Sand, fine to coarse, gray; some gravel	58 - 86

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SUMMARY OF CONSTRUCTION DETAILS FOR MONITORING WELLS

INSTALLED UNDER THE DIRECTION OF GERAGHTY & MILLER, INC.

SAUGET SANITARY DEVELOPMENT AND RESEARCH ASSOCIATION, SAUGET, ILLINOIS

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Well No.	Date Completed	Well Diameter (inches)	Depth (feet below land surface)	Screen Setting (feet below land surface)	Interval Gravel Packed (feet below land surface)	Interval Sealed With Bentonite (feet below land surface)	Interval Sealed with Grout (feet below land surface) ¹⁾	Height of Measuring Point (feet above land surface) ²⁾	Elevation of Measuring Point (feet above mean sea level) ³⁾
GM-19A	7-11-84	2	39	19 - 39	16 - 39	15 - 16	2 - 15	2.1	413.91
GM-19B	7-16-84	4	88	64 - 84	59 - 84	46 - 59	2 - 46	2.7	417.33
GM-19C	7-13-84	4	113	93 - 113	None	75 - 87	2 - 75	2.6	417.44
GM-20A	7- 5-84	2	38	18 - 38	16 - 38	15 - 16	2 - 15	2.6	411.54
GM-20B	7-10-84	4	90	70 - 90	65 - 90	52 - 65	2 - 52	2.7	411.72
GM-21A	7-13-84	2	38	18 - 38	15 - 38	14 - 15	2 - 14	3.4	414.69
GM-21B	1-15-85	4	88	64 - 84	52 - 84	47 - 52	2 - 47	-	414.74
GM-22A	7-12-84	2	38.5	18.5 - 38.5	15 - 38.5	14 - 15	2 - 14	1.9	414.41
GM-22B	1-14-85	4	88	65 - 85	62 - 85	57 - 62	2 - 57	-	416.33
GM-23	7-10-84	2	38	18 - 38	16 - 38	15 - 16	2 - 15	2.9	411.18
GM-24A	7- 9-84	2	38	18 - 38	15 - 38	14 - 15	2 - 14	2.5	408.87
GM-24B	7-31-84	4	88	68 - 88	62 - 88	52 - 62	2 - 52	2.5	408.27
GM-26A	8-13-84	2	38	18 - 38	16 - 38	15 - 16	2 - 15	2.3	425.62
GM-26B	8- 8-84	4	86	63 - 86	None	42 - 56	2 - 42	2.1	425.00

- 1) The grout was mixed with 90 percent cement and 10 percent bentonite and each well has a 2-foot thick plug of cement at the surface.
- 2) The measuring point on the 2-inch and 4-inch wells is the top of their respective well casings and not the protective outer casing
- 3) The elevation of the measuring point was determined to the top of the steel well casing for each well. The conversion to the W.G. Krummrich datum is 413.50 feet (NGVD) equals 101.00 feet (W.G. Krummrich datum).

SDMS US EPA REGION V

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IMAGERY INSERT FORM

The item(s) listed below are not available in SDMS. In order to view original document or document pages, contact the Superfund Records Center.

SITE NAME	SAUGET AREA 1		
DOC ID #	1557760		
DESCRIPTION OF ITEM(S)	SITE MAP		
REASON WHY UNSCANNABLE	<u> X </u> OVERSIZED	OR	<u> </u> FORMAT
DATE OF ITEM(S)	N. D.		
NO. OF ITEM	1		
PHASE	REM1, REM8		
PRP	RMD - SAUGET AREA 1		
PHASE (AR DOCUMENTS ONLY)	<u> </u> Remedial <u> </u> Removal <u> </u> Deletion Docket <u> </u> AR <u> </u> Original <u> </u> Update # <u> </u> Volume <u> </u> of <u> </u>		
COMMENT(S)			
FRC 716 Monitoring Well/Boring Locations/Numbers.			



EXPLANATION

- BG-1 GERAGHTY & MILLER, INC. BORING LOCATION AND NUMBER
- GM-3 GERAGHTY & MILLER, INC. MONITORING WELL LOCATION AND NUMBER
- B-101 D'APPOLONIA ROCK WELL LOCATION AND NUMBER
- B-21S ABANDONED D'APPOLONIA MONITORING WELL LOCATION AND NUMBER
 (S=Shallow, D=Deep, R=Replacement)
- B-25AB D'APPOLONIA MONITORING WELL CLUSTER LOCATION AND NUMBER
- P-1 LAW ENGINEERING MONITORING WELL LOCATION AND NUMBER
- S-3 NUMBER AND APPROXIMATE LOCATION OF SEEP
- LDW-2 ABANDONED MONSANTO MONITORING WELL LOCATION AND NUMBER
- DW-24 DEWATERING WELL LOCATION
- DW-32 MONITORING WELL LOCATION FOR THE DEWATERING PROJECT

△ G106

△ G501



P-65

▲ RA-G





December 12, 1985

Steven K. Dunn
Project Manager
Illinois Environmental Agency
2200 Churchill Road
Springfield, Illinois 62706

Dear Mr. Dunn:

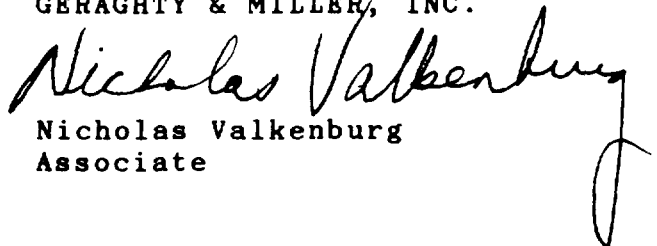
We are providing the following information regarding the study we have undertaken on behalf of Monsanto at the Sauget, Illinois facility:

1. Base map showing the locations of monitoring wells.
2. Table with construction details of wells installed by Geraghty & Miller, Inc.
3. Drilling and sampling protocols.

If you have any questions, please do not hesitate to contact us.

Very truly yours,

GERAGHTY & MILLER, INC.


Nicholas Valkenburg
Associate

NV:dv
Enc.

cc: Warren Smull

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Geraghty & Miller, Inc.

SUMMARY OF CONSTRUCTION DETAILS FOR MONITORING WELLS

MONSANTO COMPANY, W.G. KRUMMRICH PLANT, SAUGET, ILLINOIS

Well No.	Date Completed	Well Diameter (inches)	Depth (feet below land surface)	Screen Setting (feet below land surface)	Interval Gravel Packed (feet below land surface)	Interval Sealed with Grout (feet below land surface) ¹⁾	Height of Measuring Point (feet above land surface) ²⁾	Elevation of Measuring Point (feet above mean sea level) ³⁾
GM-1	11- 1-83	6	34	19 - 34	16 - 28	2 - 15	2.6 (2.3) ⁴⁾	413.65
GM-2	11- 8-83	6	41	26 - 41	None	2 - 21	2.2 (2.0) ⁴⁾	417.37
GM-3	11- 7-83	6	36	21 - 36	19 - 24	2 - 18	3.9 (3.7) ⁴⁾	411.31
GM-4A	11- 2-83	2	28	13 - 28	12 - 14	2 - 11	2.8	406.43
GM-4B	7-17-84	4	87	67 - 87	65 - 87	2 - 65	3.0	406.70
GM-4C	1-11-84	4	104	92.5-102.5	90 -102.5	2 - 90	-	406.51
GM-5	11- 3-83	2	36	21 - 36	18.5- 24	2 - 17.5	2.5	414.94
GM-6A	11- 2-83	2	34	19 - 34	16 - 22	2 - 15	2.0	414.59
GM-6B	7-26-84	4	88	68 - 88	62.5- 88	6 - 62.5	3.1	416.04
GM-7	11- 3-83	2	36	21 - 36	17 - 23	2 - 16	2.5	414.95
GM-8	11- 2-83	2	34	19 - 34	None	2 - 15	2.0	418.49
GM-9A	11-10-83	2	28	13 - 28	11.5- 15.5	2 - 10.5	2.7	414.47
GM-9B	8-17-84	4	75	55 - 75	50 - 75	2 - 50	1.9	412.36
GM-9C	8-15-84	4	108	88 -108	84 -108	2 - 84	1.5	411.97
GM-10A	11- 9-83	2	28	13 - 28	11 - 12.5	2 - 10	2.2	412.97
GM-10B	1-22-85	4	78	54 - 74	48 - 74	2 - 48	-	413.90
GM-10C	1-18-85	4	111	94 -109	85 -109	2 - 85	-	413.78
GM-11	10-31-83	2	25	10 - 25	8.5- 21	2 - 7.5	2.6	412.95
GM-12A	11- 9-83	2	33.5	18.5- 33.5	16 - 23	2 - 15	3.0	416.47
GM-12B	8-13-84	4	89	69 - 89	65 - 89	2 - 65	2.6	416.80
GM-12C	1-17-85	4	114.5	104 -114	100 -114	2 -100	-	416.79
GM-13	8-15-84	2	38	18 - 38	16 - 38	2 - 16	2.0	415.47
GM-14	8-16-84	2	38	18 - 38	16 - 38	2 - 16	2.5	411.26
GM-15	8-17-84	2	38	15 - 38	12.5- 38	2 - 12.5	2.0	413.71

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Geraghty & Miller, Inc.

SUMMARY OF CONSTRUCTION DETAILS FOR MONITORING WELLS (Cont.'d.)

Well No.	Date Completed	Well Diameter (inches)	Depth (feet below land surface)	Screen Setting (feet below land surface)	Interval Gravel Packed (feet below land surface)	Interval Sealed with Grout (feet below land surface) ¹⁾	Height of Measuring Point (feet above land surface) ²⁾	Elevation of Measuring Point (feet above mean ³⁾ sea level) ³⁾
GM-16A	8-14-84	2	38	18 - 38	16 - 38	2 - 16	2.1	412.03
GM-16B	8- 9-84	4	90	60 - 87	56 - 68	2 - 56	2.0	412.40
GM-17A	7- 6-84	2	38	18 - 38	16 - 38	2 - 16	3.0	412.57
GM-17B	7-25-84	4	78	58 - 78	52.5- 78	2 - 52.5	3.0	412.93
GM-17C	7-24-84	4	107	87 -107	80 -107	2 - 80	3.2	412.42
GM-18A	7- 5-84	2	38	18 - 38	16 - 38	2 - 16	2.6	414.23
GM-18B	7-12-84	2	92	72 - 92	68 - 92	2 - 68	2.8	414.02
GM-25A	8-14-84	2	38	13 - 38	18 - 38	2 - 16	1.4	414.20
GM-25B	7-27-84	4	88	68 - 88	62 - 88	2 - 62	3.0	415.46
GM-26A	8-13-84	2	38	18 - 38	16 - 38	2 - 16	2.3	425.62
GM-26B	8- 8-84	4	86	63 - 86	None	2 - 56	2.1	425.00
GM-27B	8- 6-84	4	82	62 - 82	55 - 72	2 - 55	2.8	426.04 (425.61) ⁵⁾
GM-27C	8- 3-84	4	115	95 -115	90 -115	2 - 90	2.9	426.76 (426.39) ⁵⁾
GM-28B	7- 3-84	4	93	70.5- 90.5	67 - 90.5	2 - 67	3.0	423.88
GM-28C	7- 5-84	4	107	87 -107	85 -107	2 - 85	2.9	423.78
GM-29	8-24-84	2	20.5	13 - 18.5	6 - 18	2 - 6	2.2	411.06
GM-30	8-30-84	2	21.2	14.2- 19.2	5 - 16	2 - 5	1.8	416.09
GM-31A	11-26-84	2	40	19 - 39	16 - 39	0 - 14	-	418.63
GM-31B	1- 9-85	4	94	65.5- 85.5	59 - 85.5	2 - 59	-	418.92
GM-31C	1- 8-85	4	126.5	97 -117	93 -117	2 - 93	-	419.29
GM-32	11-27-84	2	25	9 - 24	7 - 24	0 - 3	0.8	409.49
GM-33	11-28-84	2	25	5 - 25	4 - 25	0 - 2	2.0	410.88
GM-34	11-29-84	2	25	5 - 25	3.5- 25	0 - 1.5	2.1	410.82
GM-35	11-29-84	2	25	5 - 25	4 - 25	0 - 2	2.0	410.88

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Geraghy & Miller, Inc.

SUMMARY OF CONSTRUCTION DETAILS FOR MONITORING WELLS (Cont'd.)

Well No.	Date Completed	Well Diameter (inches)	Depth (feet below land surface)	Screen Setting (feet below land surface)	Interval Gravel Packed (feet below land surface)	Interval Sealed with Grout (feet below land surface) ¹⁾	Height of Measuring Point (feet above land surface) ²⁾	Elevation of Measuring Point (feet above mean sea level) ³⁾
GM-36	11-30-84	2	25	5 - 25	4 - 25	0 - 2.5	1.4	409.53
GM-37	11-30-84	2	25	4.3- 24.3	3 - 24.3	0 - 2	2.3	409.67
GM-38	12- 3-84	2	25	4.5- 24.5	3 - 24.5	0 - 2	2.0	412.51
GM-39	12- 4-84	2	8	3 - 8	2 - 8	0 - 1	1.9	415.59
GM-40	12- 4-84	2	8	3 - 8	2 - 8	0 - 1	2.0	415.75
GM-41	12- 4-84	2	8	3 - 8	2 - 8	0 - 1	1.2	414.75
GM-42	12- 5-84	2	8	3 - 8	2 - 8	0 - 1	1.5	414.48
GM-43	12- 5-84	2	8	2 - 7	1.6- 7	0 - 1	1.7	414.38
GM-44	12- 5-84	2	8	2 - 7	1.5- 7	0 - 1	1.6	414.44
GM-45	12- 6-84	2	18	1.5- 11.5	1 - 11.5	0 - 0.5	1.3	410.10
GM-46	12- 7-84	2	25	5 - 25	4 - 25	0 - 2.5	2.6	411.60
GM-47	12-10-84	2	10	5 - 10	4 - 10	0 - 3	-0.45	412.34
GM-48	12-10-84	2	12	2 - 12	1.9- 12	0 - 1.5	1.4	411.00
GM-49	12-10-84	2	13	3 - 13	2.5- 13	0 - 2	-0.4	408.43
B-106	6-27-85	8	165.7	None ⁶⁾	None	0 -133.5	0.5	424.82

- 1) The grout was mixed with 90 percent cement and 10 percent bentonite. All wells have a bentonite seal between the grout and the gravel pack, in addition to a 2-foot thick plug of cement at the surface.
- 2) The measuring point on the 2-inch and 4-inch wells is the top of their respective casings. On the 6-inch wells, the measuring point is the top of the water-level recorder shelter base.
- 3) The elevations were determined to the top of the steel well casings for the 2-inch wells and the 8-inch well and to the top of the recorder shelter base for the 6-inch wells. The conversions to the W.G. Krummrich datum is 413.50 feet (NGVD) equals 101.00 feet (W.G. Krummrich datum).
- 4) Height of the 6-inch casing above land surface.
- 5) Elevation of the top of the coupling.
- 6) Rock was encountered at 126 feet below land surface and an open hole exists from 133.5 to 165.7 feet below land surface.

GERAGHTY & MILLER, INC.
DRILLING AND SAMPLING PROTOCOLS

Monitoring Well Installation

The monitoring wells were installed by John Mathes and Associates, Inc., Columbia, Illinois under the direction of Geraghty & Miller, Inc. Single monitoring wells were installed at some locations but, at other locations, clusters of two or three wells were drilled in order to obtain water-level and water quality information at specific intervals in the aquifer. Wells in the clusters were installed in separate boreholes, not together in a large diameter borehole. The suffixes "A", "B" and "C" indicate shallow intermediate and deep wells, respectively. A number without a suffix indicates a shallow well.

At all shallow well locations, an 8-inch or 12-inch diameter hole was drilled with a hollow stem auger to 15 to 20 feet below the water table. Split-spoon samples were collected at 5-foot intervals, described and stored in jars. At several locations water was added to the borehole during drilling to prevent very fine sand from heaving up inside the augers. A 2-inch diameter, 6- or 10-slot, stainless steel well screen coupled to new 2-inch black steel casing was installed through the hollow-stem auger to approximately 15 feet below the water table. Gravel was added to the annular space adjacent to the well screen prior to removing

the augers to ensure that the entire annular space (to 3 feet above the top of the well screen) was properly gravel packed. The remainder of the annular space was filled with a bentonite/cement slurry which was pumped down a tremie pipe to within two feet of land surface. Pre-mix cement was poured into the remaining annulus and a steel protective pipe with a locking cap was set over the well into the cement. Finally, three 4-inch steel protective posts were installed in a triangular array to protect the wells from being damaged.

Each well was developed well with compressed air to ensure that the well screen was open to the aquifer, that the well water was reasonably clear and that all water added to each borehole during drilling had been removed. All drilling equipment and tools were steam cleaned prior to their arrival onsite, between drilling sites and prior to leaving the site to prevent cross-contamination of wells. The well screen and casing was steam cleaned prior to delivery to the site and again immediately before installation. In addition, at each drilling site all drill cuttings and development water was drummed and removed from the site for disposal in accordance with federal, state and local laws and regulations.

At all intermediate and deep well locations, an 8-inch diameter hole was drilled with the conventional rotary

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method and sampled (split spoon) to depths of 80 to 90 feet (intermediate wells) and to about 105 to 115 feet (deep wells). After the screen zone was selected, a 4-inch diameter, 20-slot, stainless steel well screen was attached to black steel casing with couplings and installed in the hole. Clean gravel was poured into the annulus next the screen as the drilling fluid was being removed. The gravel pack extends approximately 5 feet above the screen. Bentonite slurry was pumped down a tremie pipe into the annular space to form a 15 foot thick seal above the screened zone. The remainder of the annulus was filled with a bentonite/cement slurry which was also pumped down a tremie pipe to fill the remaining annulus and ensure that the well was properly sealed. A locking cap was added to the top of the well and three 4-inch steel protective posts were installed around each well in the same manner as those around 2-inch monitoring wells.

All well development and decontamination procedures followed for the shallow monitoring wells were replicated for the deeper monitoring wells, however, it was necessary to add sodium hexametaphosphate (a dispersing agent) to Well GM-28c in order to remove all of the drilling fluids.

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Water Sample Collection

All wells were sampled for USEPA Priority Pollutants, and selected wells were sampled for total organic carbon (TOC), total dissolved solids (TDS), chloride, dioxin (TCDD), and a library search was conducted for selected non-priority pollutant organic compounds. Replicate samples were collected at approximately 10-15 percent of the sampling locations. Field blanks and trip blanks were also analyzed for volatile organic priority pollutants, TDS, TOC, and chloride. Specific conductance, pH, and temperature were measured in the field at each location at the time of sample collection.

Each of the 2-inch wells were evacuated with a centrifugal pump or a stainless steel or teflon bailer. All 4-inch wells were evacuated with a submersible pump. Three to five equivalent casing volumes of water were removed from each monitoring well prior to sampling. All sampling was carried out according to a protocol that minimizes the possibility of cross-contamination of samples. Tubing attached to the pumps was dedicated to each well; no tubing was reused. Pumps were cleaned with Micro detergent solution and rinsed with distilled/deionized water. Each well was sampled with either a stainless steel or teflon bailer which

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was cleaned with Micro detergent solution, hexane and distilled water rinses after the sampling of each well.

Blind replicate samples (except sample for volatile organic compound) were collected in a common container before splitting the sample. Well water collected for priority pollutant metal analysis was filtered in the field according to the USEPA protocol. All other samples were stored and preserved in accordance with USEPA protocols and instructions provided by the analyzing laboratory. Samples were delivered to the laboratory within 24 hours of collection, following Geraghty & Miller, Inc.'s daily sampling activities.

GERAGHTY & MILLER, INC.
DRILLING AND SAMPLING PROTOCOLS

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Monitoring Well Installation

The monitoring wells were installed by John Mathes and Associates, Inc., Columbia, Illinois under the direction of Geraghty & Miller, Inc. Single monitoring wells were installed at some locations but, at other locations, clusters of two or three wells were drilled in order to obtain water-level and water quality information at specific intervals in the aquifer. Wells in the clusters were installed in separate boreholes, not together in a large diameter borehole. The suffixes "A", "B" and "C" indicate shallow intermediate and deep wells, respectively. A number without a suffix indicates a shallow well.

At all shallow well locations, an 8-inch or 12-inch diameter hole was drilled with a hollow stem auger to 15 to 20 feet below the water table. Split-spoon samples were collected at 5-foot intervals, described and stored in jars. At several locations water was added to the borehole during drilling to prevent very fine sand from heaving up inside the augers. A 2-inch diameter, 6- or 10-slot, stainless steel well screen coupled to new 2-inch black steel casing was installed through the hollow-stem auger to approximately 15 feet below the water table. Gravel was added to the annular space adjacent to the well screen prior to removing

the augers to ensure that the entire annular space (to 3 feet above the top of the well screen) was properly gravel packed. The remainder of the annular space was filled with a bentonite/cement slurry which was pumped down a tremie pipe to within two feet of land surface. Pre-mix cement was poured into the remaining annulus and a steel protective pipe with a locking cap was set over the well into the cement. Finally, three 4-inch steel protective posts were installed in a triangular array to protect the wells from being damaged.

Each well was developed well with compressed air to ensure that the well screen was open to the aquifer, that the well water was reasonably clear and that all water added to each borehole during drilling had been removed. All drilling equipment and tools were steam cleaned prior to their arrival onsite, between drilling sites and prior to leaving the site to prevent cross-contamination of wells. The well screen and casing was steam cleaned prior to delivery to the site and again immediately before installation. In addition, at each drilling site all drill cuttings and development water was drummed and removed from the site for disposal in accordance with federal, state and local laws and regulations.

At all intermediate and deep well locations, an 8-inch diameter hole was drilled with the conventional rotary

method and sampled (split spoon) to depths of 80 to 90 feet (intermediate wells) and to about 105 to 115 feet (deep wells). After the screen zone was selected, a 4-inch diameter, 20-slot, stainless steel well screen was attached to black steel casing with couplings and installed in the hole. Clean gravel was poured into the annulus next the screen as the drilling fluid was being removed. The gravel pack extends approximately 5 feet above the screen. Bentonite slurry was pumped down a tremie pipe into the annular space to form a 15 foot thick seal above the screened zone. The remainder of the annulus was filled with a bentonite/cement slurry which was also pumped down a tremie pipe to fill the remaining annulus and ensure that the well was properly sealed. A locking cap was added to the top of the well and three 4-inch steel protective posts were installed around each well in the same manner as those around 2-inch monitoring wells.

All well development and decontamination procedures followed for the shallow monitoring wells were replicated for the deeper monitoring wells, however, it was necessary to add sodium hexametaphosphate (a dispersing agent) to Well GM-28c in order to remove all of the drilling fluids.

Water Sample Collection

All wells were sampled for USEPA Priority Pollutants, and selected wells were sampled for total organic carbon (TOC), total dissolved solids (TDS), chloride, dioxin (TCDD), and a library search was conducted for selected non-priority pollutant organic compounds. Replicate samples were collected at approximately 10-15 percent of the sampling locations. Field blanks and trip blanks were also analyzed for volatile organic priority pollutants, TDS, TOC, and chloride. Specific conductance, pH, and temperature were measured in the field at each location at the time of sample collection.

Each of the 2-inch wells were evacuated with a centrifugal pump or a stainless steel or teflon bailer. All 4-inch wells were evacuated with a submersible pump. Three to five equivalent casing volumes of water were removed from each monitoring well prior to sampling. All sampling was carried out according to a protocol that minimizes the possibility of cross-contamination of samples. Tubing attached to the pumps was dedicated to each well; no tubing was reused. Pumps were cleaned with Micro detergent solution and rinsed with distilled/deionized water. Each well was sampled with either a stainless steel or teflon bailer which

was cleaned with Micro detergent solution, hexane and distilled water rinses after the sampling of each well.

Blind replicate samples (except sample for volatile organic compound) were collected in a common container before splitting the sample. Well water collected for priority pollutant metal analysis was filtered in the field according to the USEPA protocol. All other samples were stored and preserved in accordance with USEPA protocols and instructions provided by the analyzing laboratory. Samples were delivered to the laboratory within 24 hours of collection, following Geraghty & Miller, Inc.'s daily sampling activities.